Report of the

Bureau of Engineering

1928-1929

Department of Public Works

City and County of
San Francisco

M. M. O'SHAUGHNESSY
City Engineer

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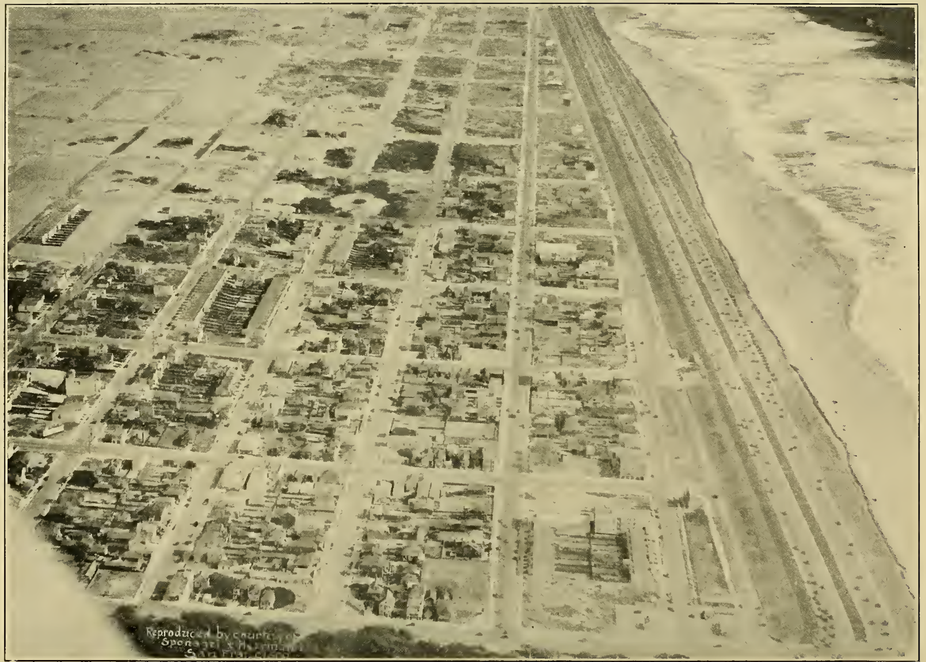

GREAT HIGHWAY
Two 50-foot roadways stretching two miles along the ocean beach

REPORT

OF THE

BUREAU *of* ENGINEERING

OF THE

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF
SAN FRANCISCO

* * *

FISCAL YEAR ENDED JUNE 30, 1929

* * *

JAMES ROLPH, Jr. . . . *Mayor*

TIMOTHY A. REARDON
CHARLES E. STANTON
FRED W. MEYER
Board of Public Works

M. M. O'SHAUGHNESSY
City Engineer

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(1928-29)

Report of the Bureau of Engineering

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF SAN FRANCISCO
1928-1929

To the Honorable,
The Board of Public Works of the
City and County of San Francisco.

Gentlemen:

Herewith I transmit the annual report of the Bureau of Engineering for the fiscal year ended June 30, 1929.

Construction of boulevards with funds from the bond issue authorized in November, 1927, and of the Bernal Cut, authorized June 14, 1927, has progressed in a satisfactory manner. The recently completed Great Highway, three miles long, has been hailed as the finest in the country. The new Judah Street Municipal Railway line to the Ocean Beach has become next to the best paying line of the municipal system. Some improvement has been made at the Airport but additional funds are urgently needed. Sewer construction, long restricted by meager annual appropriations, may be carried on by proceeds of the bond issue authorized in November, 1928. Hope for successful negotiation of a permit for a bay bridge has been revived by action of the legislature vesting authority for bridge building in the State of California.

It is deeply to be regretted that the state of the bond market has temporarily prevented the sale of 4½% bonds necessary to purchase the system of the Spring Valley Water Company.

In the Hetch Hetchy Water Supply system, continued successful operation is reported of the Mountain Division including the Moccasin Power Plant, and the Bay Crossing Division.

Construction of the Foothill Division Tunnels, 15.8 miles in length, from Moccasin to the San Joaquin Valley is practically complete. The dam at the tail race of Moccasin Power House will be finished by winter.

Construction of the Coast Range Tunnel, 28.6 miles in length, from the San Joaquin Valley to Irvington is well along with over 4 miles driven and it is expected that the work will be completed in 1932.

Although the seasonal rainfall has been much below normal, the reservoirs of the local water system contain water enough to last for over a year.

An exhaustive study and report on the street railway operation has been made, which will form a basis for all future action toward unification of our railway system.

I must commend the efforts and loyal assistance of the staff of this office, especially Nelson A. Eckart, Chief Assistant, in direct charge of Hetch Hetchy and other utilities, Clyde E. Healy, Second Assistant, in charge of local improvements, street and sewer construction, and Paul J. Ost, electrical engineer in charge of power and railway engineering. I am indebted to L. B. Cheminant, Assistant Engineer, for preparation and compilation of this report.

Respectfully,

San Francisco,
August 1, 1929.

M. M. O'SHAUGHNESSY,
City Engineer.

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ORGANIZATION AND PERSONNEL

M. M. O'Shaughnessy	City Engineer	
N. A. Eckart	Chief Assistant Engineer	Utilities, Tunnels, Railway and Water.
C. E. Healy	Second Assistant Engineer	General City Engineering, Streets, Boulevards, Sewers, etc.
W. H. Ohmen	Assistant Engineer	Design of Special City Projects, Airport, Structures, Boulevards, Sewers, etc.
J. M. Owens	Assistant Engineer	Street Improvement Design.
W. C. Pidge	Assistant Engineer	Street Improvement Investigation and Permits.
L. R. Mercado	Inspector	Street Improvement Investigation and Permits.
E. E. Jordan	Surveyor	Street Improvement Assessments, Complaints, etc.
G. F. Stahle	Surveyor	Street Grades.
H. J. Stahle	Surveyor	Surveys.
Geo. D. Burr	Traffic Engineer	Traffic.
P. J. Ost	Electrical Engineer	Electrical and Street Railway Engineering.
L. W. Stocker	Assistant Engineer	Water Supply Engineering.
L. B. Cheminant	Assistant Engineer	Reports, Publicity, etc.
H. W. Kephart	Purchasing Agent	Water Supply Purchasing, Correspondence, etc.
J. J. Phillips	Right of Way Agent	Lands and Rights of Way.
C. L. Cook	Engineering Chemist	Chemical and Testing Laboratory.
H. B. Chaffee	Photographer	Photography and Blueprinting.
F. O. Shutts	Assistant Engineer	Supervising Street and Sewer Construction.
C. M. Taylor	Inspector	Supervising Major Local Construction, Boulevards, etc.
F. J. Sheehan	Assistant Mechanical Engineer	Supervising Street Railway Construction and Maintenance.
L. Glick	Assistant Engineer	Contract Payments, Payrolls.
L. T. McAfee	Construction Engineer	Supervising Construction of Foothill Division of Hetch Hetchy.
C. R. Rankin	Construction Engineer	Supervising Construction of Coast Range Division of Hetch Hetchy.
Thornton Easler	Assistant Electrical Engineer	Supervising Power Operation of Hetch Hetchy.
Willis O'Brien	Auditor	Hetch Hetchy Water Supply.

Retired from service in accordance with the provisions of the San Francisco City Employees' Retirement System:

John Schlotzhauer, Surveyor	October 31, 1928
L. E. Fenton, Field Assistant	January 31, 1929

BOULEVARDS, STREETS, AND HIGHWAYS

The boulevard work authorized on November 8, 1927, has proceeded satisfactorily with funds from the sale of $5,000,000 of bonds. The letting of new contracts will require additional bond sales shortly. Spirited competition amongst contractors has resulted in the work being done at very low prices. Land purchases have been made at very reasonable figures. It appears now, with the boulevard projects about 70 per cent completed, that a surplus may be developed sufficient not only to buy the lands necessary for Sunset Boulevard as originally contemplated but also to accomplish some of its construction.

In all boulevard construction, permanent paving is laid immediately where the subgrade is in a satisfactorily compacted condition. On fills or other places liable to settlement, a temporary pavement is laid. This consists of water-bound macadam 8 in. thick with wearing surface of either asphaltic concrete, oiled macadam or emulsified asphalt. The grade of the finished temporary pavement is so fixed that the macadam will serve as a foundation for the concrete base of the permanent pavement, which will be laid when the fill shall have become thoroughly compacted after a season or more of weathering.

Permanent paving on all the boulevards, except the Great Highway, consists of 8 in. of concrete base, 1½ in. of asphaltic binder, and 1½ in. of asphaltic concrete wearing surface. On the Great Highway, which is used almost entirely by pleasure vehicles, the pavement consists of a 10-in. macadam base with a 2-in. asphaltic concrete wearing surface.

For concrete base, the mix is approximately 1 part of cement to 5.5 parts of aggregate. Specifications require 6 sacks of cement per cubic yard of concrete, with sufficient water to produce a slump of 1½ in. Aggregate generally runs 1 part of fine to 2 of coarse.

The specifications provide that concrete that is to be hand finished shall be poured in 10-ft. strips, but that if mechanical spreaders be used, the contractor may pour strips 20 ft. wide. All concrete work in progress is being spread and finished by a machine mounted on header boards and with a strike-off plate shaped to the crown of the roadway. Contraction is provided for by weakened planes or dummy joints ¼-in. wide and 2 in. deep, spaced in the concrete at 25-ft. intervals, filled with asphalt to within ½ in. of the surface.

Curing was done on some of the earlier work by water and diking, but on all later work it has been considered advisable to use an asphalt spray coat. A very thin coat of asphaltic cement is sprayed on the cured concrete prior to the placing of the binder course. Close attention on the part of the inspectors results in concrete showing a 7-day test of about 3000 lbs. and a 28-day test of about 4200 lbs.

The asphaltic binder is composed as follows (by weight): Asphaltic cement, 4% to 6%; stone dust, 4% to 6%; sand, 20% to 35%; coarse aggregate, 72% to 53%.

The asphaltic concrete wearing surface consists (by weight) of: Asphaltic cement, 6% to 8%; mineral aggregate, consisting of broken stone or gravel, sand, and stone dust, 94% to 92%.

Both binder and wearing surface are spread with a mechanical spreader with a raking attachment. Rolling is done with a 3-wheeled 12-ton roller followed by an 8-ton tandem roller. The finished surface must be true and uniform, with no rolls or depressions in any 10 ft. exceeding ¼ in. from the true grade and cross section of the finished strip.

Conduits for lighting standards and traffic signals, and public utility pipes and ducts are being laid now to avoid tearing up the pavement in future. Erection of electroliers has come to a decided stop due to deliberations of the Supervisors, who questioned the type selected by the City Engineer.

Pedestrian subways are being constructed on the more important boulevard intersections. Locations are determined by this office, after consultation with the Police Department, the Board of Education, and other interested public bodies.

Two types of construction are used—a standard section for crossing under ordinary streets, and an extra heavy section for use under steam railroad tracks.

The standard subway is a tunnel 6 ft. wide by 7 ft. 3 in. high, reached by stairways 5 ft. wide located within the sidewalk lines. The stairway, with its balustrades, would be a serious encroachment on the sidewalk area, especially where the width of the sidewalk is 12 ft. or less. In some cases, additional width has been obtained by the purchase of a few feet of land. In one case, the use of different curvature at the property line, and at the curb line, gave sufficient additional width.

The most desirable depth is with the floor at 11 ft. below curb grade. This requires special diversion of sewer lines, one method being an offset to pass around the stairway, within the sidewalk area.

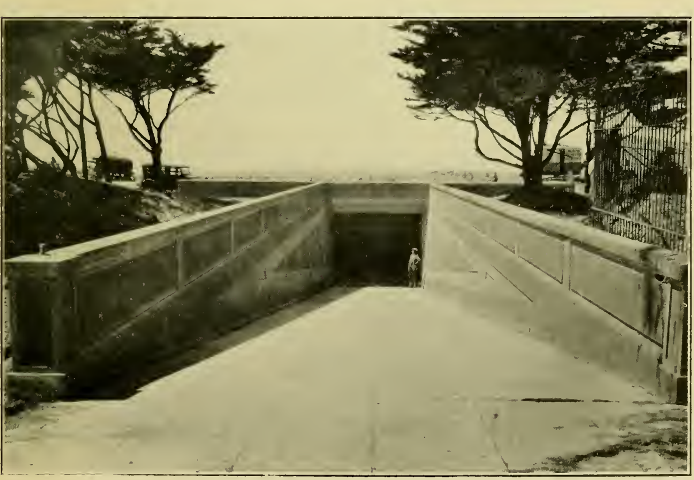
Drainage of the subway is either direct to the sewer or to a small sump from which the accumulated water may from time to time be drawn off to a sewer by use of an ejector operated either electrically or from the city water pipe.

Water, gas, and electric conduits pass through the space between the top of the subway and the bottom of the pavement.

Lighting is by lamps set in recesses at 20 ft. intervals on both sides of the subway. A special device is used to minimize danger of pilfering.

Bay Shore Boulevard extends from Potrero Avenue to the County line, a distance of 3.01 miles. Part of the location is along former streets which have been widened and straightened. The new roadway is 100 ft. in width. There are also two sidewalks 12½ ft. wide. Although most of the grades are very flat, an 8 per cent grade was necessary in climbing

On Bay Shore Boulevard at Burrows Street



On Great Highway at the Beach Chalet
PEDESTRIAN SUBWAYS

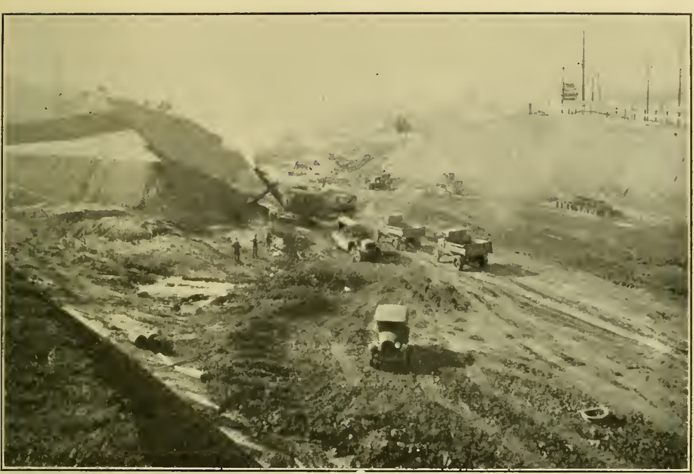
PEDESTRIAN SUBWAY
On Alemany Boulevard at Santa Rosa Avenue

the hill south of the Islais Creek crossing. The City's work was divided for construction purposes into 5 units, called Sections A, B, C, D, and E.

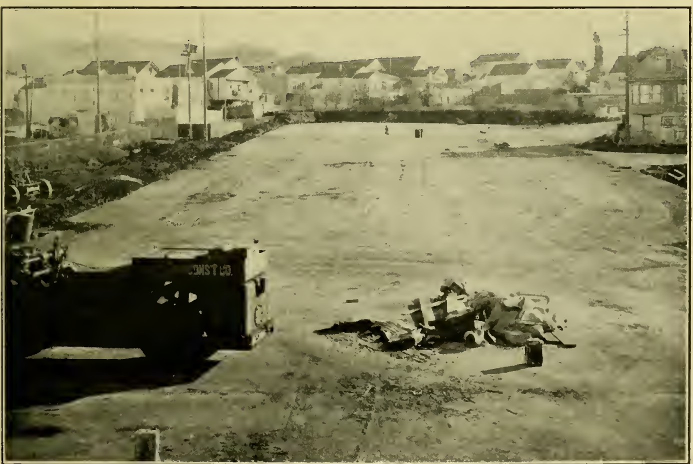
Section A is 6000 ft. long from Potrero Avenue to Silver Avenue. About 77 per cent of the work under the contract let in June, 1928, has been completed. A temporary pavement has been placed where the subgrade is liable to settlement. The new boulevard follows for some distance the line of San Bruno Avenue, one of the main outlet streets of the City. This avenue has been widened and straightened, and the street railway tracks have been relocated and reconstructed. This latter work proved particularly difficult and resulted in considerable delay. The new boulevard is in use continuously.

Section B follows the line of Charter Oak Avenue from Silver Avenue to Paul Avenue, a distance of 3719 ft. The work was completed February 21, 1929.

Section C extends diagonally through the blocks of built-up resi-



Bay Shore Boulevard. A 52-foot cut, 125 feet wide



Bay Shore Boulevard. End of Sec. B and beginning of Sec. C. showing improvements to be removed

BOULEVARD CONSTRUCTION

dential sections 2119 ft. from Paul Avenue to Third Street. The acquisition of the necessary properties delayed the receipt of proposals until April 3, 1929. The contract was awarded on April 8 to Municipal Construction Company for the estimated amount of $74,123.30, and work is being carried on under a schedule calling for completion by October, 1929. To date 7 per cent of the work is completed.

Section D, extending 1600 ft. from Third Street to Tunnel Avenue, involves the grading of 200,000 cu. yds. of rock; the maximum depth of cut is 52 ft. The contract was awarded on August 27, 1928, to Granfield, Farrar, and Carlin, for the estimated amount of $212,805.66. The work is now 88 per cent complete.

Section E is 2500 ft. in length from Tunnel Avenue to the San Mateo County line. Immediately following the acquisition of the necessary properties, contract was awarded on February 11, 1929, to Federal Construction Company for the estimated amount of $107,115.38, and the work is now 35 per cent complete. Relocation of street car tracks is necessary here, as was the case in Section A.

Alemany Boulevard extends 4.8 miles from Bay Shore Boulevard near Cortland Avenue to Junipero Serra Boulevard near the County line. It occupies the right of way of the former Ocean Shore Railway, which discontinued operations several years ago. This right of way, originally 60 ft. wide, was purchased by the City and was increased to 100 ft. to widen the roadway. The boulevard has an 80-ft. roadway and two 10-ft. sidewalks.

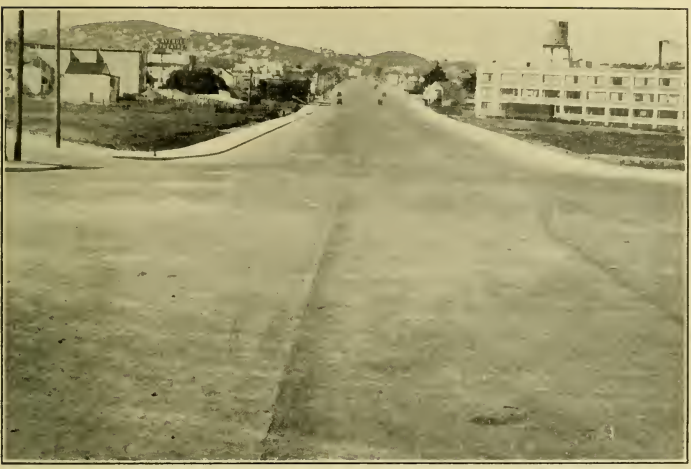
Three pedestrian subways are being constructed. At Mission Street, the viaduct completed in 1911 provides complete grade separation between the two main arteries.

For construction purposes, the boulevard has been divided into 6 units: A, B, C, D, D1, and E.

Section A extends 7100 ft. from Bay Shore Boulevard to Mission Street. Plans for this section are prepared, and all purchases of rights of way are completed, but construction cannot be begun until certain sewer work shall first be done.

In the annual report for the fiscal year 1927-28, note was made of the necessity for a bond issue for construction of a main sewer along this boulevard. The issuance of 4½ per cent sewer bonds was authorized in the election of November 6, 1928, but, owing to the condition of the bond market, no bonds have yet been sold. It is planned to sell, at an early date, enough sewer bonds to carry on this construction, thus allowing the boulevard work to proceed.

Section B, from Mission Street to Ocean Avenue, is 3900 ft. long. Work under the contract awarded to Eaton and Smith on March 10, 1928, was finally completed in March, 1929, although it had been conditionally accepted in January.



Bay Shore Boulevard, 125 feet wide, with 100-foot roadway

Alemany Boulevard, 100 feet wide, with 80-foot roadway
Mission viaduct in background
COMPLETED BOULEVARDS

Section C, from Ocean Avenue to San Jose Avenue, is 7800 ft. long. About 65,000 cu. yds. of waste from the Bernal Cut has been used to fill the low areas. Property acquisitions, reported last year as in progress, have now been completed, and at an early date a contract should be let for grading, paving, construction of concrete walls and curbs, and for alteration of some existing sewers.

Section D and D1 are alternate routes from San Jose Avenue to Orizaba Avenue. The direct route, Section D, is 1630 ft. in length. Grade separation at the Southern Pacific Railroad will be very expensive, so the alternative route D1 will be used until the increase of crosstown traffic on Plymouth Avenue makes advisable the construction of the direct route. Contract for this section was awarded on September 12, 1928, to Hanrahan Company for the estimated amount of $49,884.12, but the right of way acquisition is not yet complete, and the work has not begun. One parcel could not be purchased amicably, so condemnation proceedings were resorted to. The jury set a value far in excess of the City's appraisal, so the City declined to purchase. Negotiations in progress indicate that the land may be bought at a price substantially less than that set by the court.

Section E is 2710 ft. long from Orizaba Avenue to Junipero Serra Boulevard. The initial contract awarded to Granfield, Farrar and Carlin, signed on August 31, 1928, which included grading, sewers, and permanent paving of half the roadway, was completed in May, 1929. In the meantime, the fill which constituted the other half of the roadway had become sufficiently compacted so that final contract was let on April 29, 1929, to Federal Construction Company for the estimated amount of $28,907 for paving and construction of curbs. Work was begun in June and is now 32 per cent complete.

Junipero Serra Boulevard extends from the intersection of Sloat Boulevard and Portola Drive, a distance of 1.8 mi. This has been one of the most popular routes connecting to both Skyline Boulevard and El Camino Real, but traffic has been throttled by the narrow 25-ft. pavement. Reconstruction of this boulevard will provide a 100-ft. roadway and two 12½-ft. sidewalk areas. Negotiations with Spring Valley Water Company for rights of way for this boulevard and also for the Nineteenth Avenue Extension were protracted. It was not until March 25, 1929, that contract was awarded to Eaton and Smith for the estimated amount of $347,396.50. The contractor's schedule calls for completion of the work by February, 1930. At present 4 per cent has been done.

Junipero Serra Boulevard Extension begins at the county line and extends southerly and southeasterly into San Mateo County. This construction is financed by Joint Highway District No. 10, in which San Francisco assumes 85 per cent and San Mateo County 15 per cent of the cost. Its object is the development of a new and independent highway to Santa Clara County, following the route of Alameda de las Pulgas in the low hills back of Atherton and Redwood City. The construction of this highway and the further extension of the Bay Shore Highway will relieve the congestion of the present State highway, El Camino Real, which recently showed a traffic count of 30,000 vehicles in 16 hours.

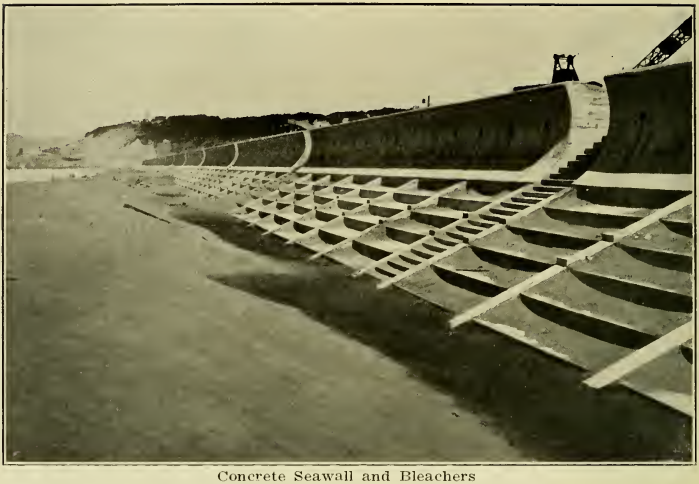
The first link of this extension, known as "Unit A," from the county line to School Street at Colma, is 1.1 mi. in length. Plans and specifications for the construction of Unit A have been prepared in this office, and it is expected that bids will be called for within 60 days. The intention is to provide a 125-ft. right of way, and for the present to grade it to full width and construct initially a 60-ft. roadway, consisting of an 8-in. water-bound macadam base with 1½-in. oiled macadam or 2-in. asphalt top. Shoulders of water-bound macadam 4 in. thick and 10 ft. wide, concrete gutters 5 ft. wide, and on the west side an oiled macadam walk 6 ft. wide will also be built.

Unit B, extending from School Street to the Colma-San Pedro Road, a distance of ⅔ mi., will be constructed subsequently as soon as funds are available, the expectation being that this will be within one year. Construction of other units will follow as quickly as possible.

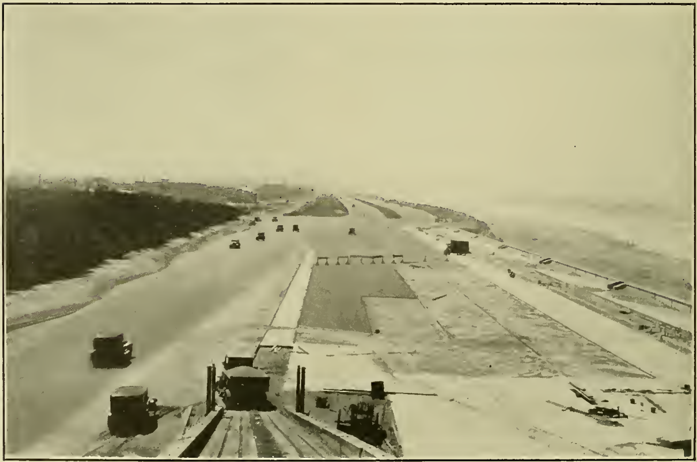
Nineteenth Avenue Extension from Sloat Boulevard to Junipero Serra Boulevard at Worcester Avenue, a distance of 1.3 mi., was delayed also by negotiations for rights of way from the Water Company. Contract was awarded on February 25, 1929, to Eaton and Smith for the estimated amount of $257,142.60, and the work is now 22 per cent complete. The contractor's schedule calls for completion by November, 1929. The roadway will be 80 ft. wide from Sloat Boulevard to the intersection with the Municipal Railway. From this point there will be a 44-ft. roadway on each side of the 32-ft. railway right of way. There will be two 10-ft. sidewalk areas for the entire length of boulevard. On each of these, as in the Junipero Serra Boulevard, there will be a 6-ft. stone sidewalk and an area planted to veronica and ice plant.

Sunset Parkway is what was formerly the block between Thirty-sixth and Thirty-seventh Avenues, 240 ft. wide and 2.1 mi. long from Golden Gate Park to Sloat Boulevard. Although the original intention was merely to purchase the lands for this boulevard out of the present bond funds, savings effected may be sufficient to finance also the construction of a portion of this highway. At present about 75 per cent of the lands required have been purchased.

Ocean Beach Esplanade is the broad highway and parking space along the ocean beach frontage, reaching from the bluffs south of the Cliff House to the southerly line of Golden Gate Park, a distance of 4298 ft., of which 2232 ft. were completed during this fiscal year. Two walks 20 ft. wide, a 15-ft. lawn, and a roadway varying in width from 188 ft. to 199 ft., are protected from erosion by the waters of the Pacific Ocean by erection of a concrete seawall. Rising from the sand beach are stepped, reinforced



Concrete Seawall and Bleachers



Roadway 200 feet wide, 20-foot sidewalks, and lawn
Great Highway in background
OCEAN BEACH ESPLANADE

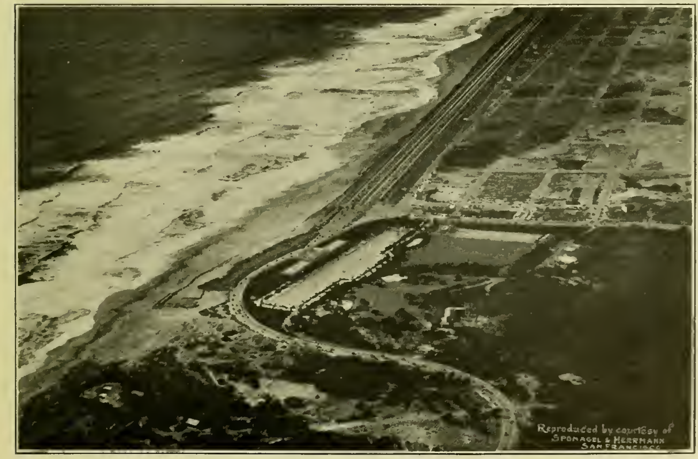
concrete bleachers. Back of these is the sea wall proper, its shape so designed as to check the ocean waves gradually and then turn them back without splashing or inundating the esplanade.

The work done this year is a continuation of various installments begun in 1914. Prior to that time, the Great Highway, as the shore boulevard is known, had been washed away from time to time by giant breakers during great storms. Some protection had been afforded the Beach Chalet by a barrage of piles driven in the sand beach under the direction of the Park Commission, but the line of piles was very unsightly and of doubtful utility.

Before undertaking construction of the Esplanade sea wall, this office made extensive studies of sea protective work in the United States and in Europe. There have been many failures of such work previously constructed, but although the conditions here are difficult, largely on account of the sand foundation which extends to a depth of at least 200 ft., it is felt that we now have an adequate, permanent wall, which is both useful and ornamental.

Two contracts were awarded to Healy Tibbitts Construction Company for this work, one covering the general construction, which has already been completed, and one the paving which is 54 per cent complete and should be finished by August, 1929.

Great Highway from Golden Gate Park to Sloat Boulevard, 2 mi. in length, has been completed to form a most beautiful boulevard. The



GREAT HIGHWAY
Two Miles of Double 50-Ft. Roadway, separated and bordered by lawn and shrubbery, and one mile of broad esplanade and boulevard to the Cliff House

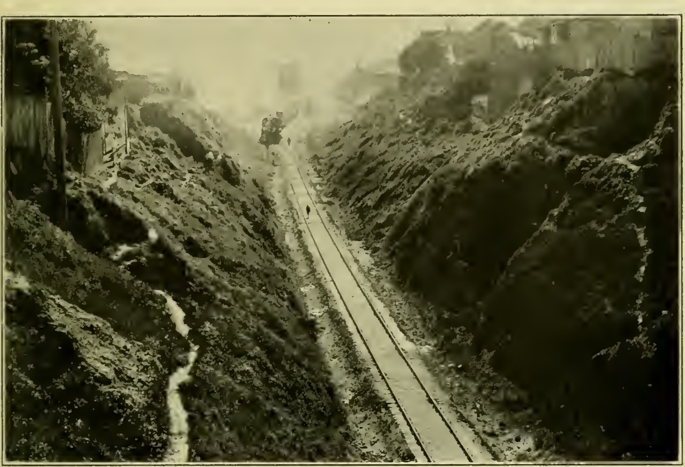
development consists of two 50-ft. roadways, separated by a 25-ft. parked area, with walks, bridle path, ornamental shrubbery, and lawn, as described in the annual report for the preceding fiscal year. Pedestrian subways are provided at the more important crossings to allow free access to the ocean beach. Great Highway and Esplanade, extending a total distance of almost 3 miles, with widths from 250 to 324 ft., constitute one of the finest boulevards in the country and afford thousands of people opportunity to view the inspiring beach of the Pacific Ocean.

Contract was awarded on July 16, 1928, to Granfield, Farrar and Carlin for the estimated amount of $131,121, but in September, 1928, a change to permanent type of pavement increased this amount to $225,198.25. The work was completed in April, 1929, but was not immediately thrown open to public use, as the Supervisors were dissatisfied with the electroliers specified by this office. Formal opening and dedication was held on June 9, 1929.

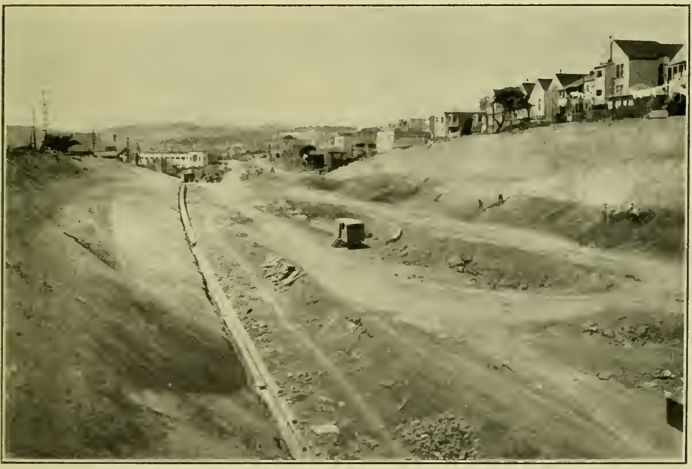
Van Ness Avenue Extension is the last item of the $9,380,000 boulevard bond program. It contemplates the extension of Van Ness Avenue South from its present terminus at Mission Street, diagonally to Howard Street at Thirteenth Street. This is preliminary to the development of Howard Street as a boulevard, and will produce a north and south artery 4 mi. long from Twenty-sixth Street to the bay at the foot of Van Ness Avenue.

The City Engineer's plan for a straight extension met with considerable opposition from some supervisors who, on the plea of economy, wished to introduce some bends in alignment, but eventually the original straight plan was adopted. Some parcels of land have been acquired, but the remainder will have to await the marketing of additional bonds.

Bernal Cut Boulevard construction is proceeding expeditiously, although the contractor is somewhat behind the time schedule. After a delay by the Board of Supervisors' failing to authorize the Mayor to enter into an agreement with the Southern Pacific Company for exchange of lands, contract was awarded on October 3, 1928, to MacDonald and Kahn for the estimated amount of $504,829.39, including demolishing the old Bosworth Street bridge, building new bridges at Highland Avenue, Richland Avenue, and Bosworth Street, excavation, and constructing sidewalks, fence, sewers, and rubble walls. This contract is now 25 per cent complete. The schedule calls for completion by April, 1930. The Supervisors, on request of some interested property owners, directed that a vehicular bridge, instead of one for pedestrian use, be built at the Richland Avenue crossing.



Railroad Cut before widening to 117½ feet for boulevard, railways and walks



Construction Progress, July 1, 1929

BERNAL CUT

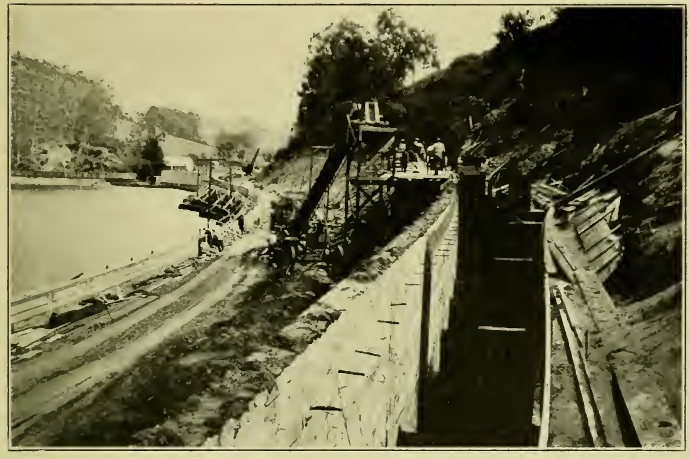
Laguna Honda Boulevard is being built out of the City's allotment of the State gasoline tax. Until now a heavy stream of crosstown traffic has been carried on a narrow roadway along the edge of Lake Honda, one of the principal distributing reservoirs of the Spring Valley Water Company. Plans were completed several years ago for construction of an adequate roadway but, until now, funds for the construction have never been available. The annual report for the fiscal year 1927-1928 noted the beginning of construction of a sewer along the line of the boulevard. This work was completed in November, 1928, and on December 31 the contract for boulevard construction was awarded to J. P. Holland for the estimated amount of $103,520.58. The work is now 75 per cent complete. Description of the boulevard was printed in the last annual report, to which reference is here made.

Shoring of a steep sandhill during the construction of the L-type retaining wall, which reaches a maximum height of 30 ft. has required extreme care and skill on the part of the contractor. To hold this bank he used 3 in. by 12 in. horizontal lagging on vertical posts varying from 8 in. by 8 in. to 12 in. by 14 in. at 6 ft. centers, extending 7 ft. below subgrade, with either one or two inclined shores to anchors excavated in the roadway. The vertical posts of maximum length of 40 ft. were set in holes excavated by a special well-boring machine. There has been absolutely no caving or running of the bank and both the subcontractors, Meyer Bros., and the City's engineers, C. M. Taylor and J. B. West, who devised the method, are to be commended.

Kezar Stadium Roadway is a roadway 60 ft. wide extending from Stanyan and Waller Streets diagonally through Golden Gate Park to Lincoln Way at Third Avenue, a distance of 2063 ft. The construction of this road was a relief to Sunset traffic that has been persistently agitated by this office for several years.

Contract for grading, sewer construction and paving with 8 in. concrete base and 2 in. Topeka cover was awarded September 14, 1928, to Eaton and Smith for the estimated amount of $55,161.10, and the work was completed in December, 1928. Considerable extra work, especially the installation of conduits for lighting and traffic signals was authorized during the progress of the contract. Standards for these signals were erected but the placing of the signals is delayed because the Park Superintendent objects to the yellow color that is standard for these signals.

Portola Drive is the continuation of Market Street Extension from Twenty-fourth Street to Fowler Avenue, a distance of 3950 ft. The proposed widening of roadway to 80 ft. with two 10-ft. sidewalks was noted in the annual report for the last fiscal year. Bids for this work were received June 26, 1929, and contract awarded July 1 to Fay Improvement Company for the estimated amount of $125,083.60. The completion of this construction will give a broad, easy grade boulevard, with exception-



LAGUNA HONDA BOULEVARD
Two retaining walls, one 30 feet high, were built as part of this work

KEZAR STADIUM ROADWAY

ally beautiful view, from the head of Market Street to a connection with Sloat Boulevard to the ocean beach and Junipero Serra Boulevard to the south.

Roosevelt Way is to be extended from Buena Vista Terrace to Fourteenth Street, under contract awarded June 17, 1929, to Chas. L. Harney for the estimated amount of $9,685.80.

Bernal Heights Boulevard is a roadway which begins at Powhattan Avenue and Nevada Street, and rises on an easy grade to Esmeralda Avenue and Alabama Street, a length of about 1100 ft. From this point the roadway encircles the proposed 26-acre Bernal Heights Park, being projected around the hill on a practically level grade for a distance of 5000 ft. The boulevard has a 36-ft. roadway and two 7-ft. sidewalks on a 50-ft. right of way.

Contract No. 1, for the construction of the boulevard approach, was awarded on February 27, 1929, to E. J. Treacy for the estimated sum of $5140.40.

Ocean Shore Highway is an inter-county road from San Francisco to Santa Cruz. It begins at the Skyline Boulevard about one mile south of the connecting road from Junipero Serra Boulevard Extension at Colma, and extends southerly 76 mi. to Santa Cruz. In general, it follows the abandoned roadbed of the former Ocean Shore Railway.

The tentative general location was decided by a conference of the County Surveyors of San Mateo and Santa Cruz Counties and this office. For this purpose, aerial photographs of the entire area were first taken, and a photographic map was made on a scale of 1000 ft. per in. The preliminary estimate of cost was $5,300,000 for a 20-ft. pavement, with the roadway graded to a 40-ft. width on a 100-ft. right of way.

To handle the work, there has been formed Joint Highway District No. 9 of the State of California, consisting of San Francisco, San Mateo, and Santa Cruz Counties; these counties will bear 55, 30 and 15 per cent respectively of the costs. Detail engineering will be by each County Surveyor in his own county.

The first units of construction are to be a new grade around San Pedro Mountain, and a permanent road at Waddell Beach. The new road around San Pedro Mountain is estimated to cost $670,000 and a tax to yield this amount will be levied by the District. The road will extend from Rockaway to Montara, rising to a summit 200 ft. above the ocean at Devil's Slide. The old railroad tunnel at San Pedro Point will be cleaned and rehabilitated for highway use. The new road will not only open up some wonderful scenic views, but will shorten the present Santa Cruz route by three miles.

Presidio Roadway:

The roadway from the barracks near Fort Point connecting at Lobos Creek to El Camino del Mar has been reconstructed during the year by the United States Government with the aid of the City, which furnished the cement, the road construction machines and operators. This road offers a beautiful view of the Golden Gate but has been shunned on account of the miserable pavement. Although it is within the Military Reservation, it was necessary for the City to assist in the reconstruction.

Miscellaneous Street Construction:

The amount of street improvement remains about equal to that of the preceding year. Again by far the greatest part of the work is in the districts along the ocean slope, especially the Sunset, and the areas westerly and southwesterly from Twin Peaks Boulevard. The operation of the Municipal Railway through the Sunset Tunnel, and the completion of main trunk sewers through the Sunset District, have combined to make habitable great areas of sand and desert.

Important development of streets and sewers is noted also in the industrial area tributary to the Bay Shore Boulevard, in the valley of Islais Creek from Mission Viaduct westerly, in Bernal Heights, and in the ocean slope from Lakeview Heights westerly.

EL CAMINO DEL MAR THROUGH PRESIDIO
Highway along Golden Gate, built by Federal Government with aid of San Francisco

Widening Streets:

The work of widening street roadways by setting back curbs has increased during the year. The following list, furnished by the Street Repair Department of the Board of Public Works, indicates the amount of work done:

Geary Street from Van Ness Avenue to Divisadero Street.
Duboce Avenue from Noe Street to Market Street.
Grant Avenue from Columbus Avenue to Filbert Street.
Eighth Street from Mission Street to Market Street.
First Street from Harrison Street to Folsom Street.
Fulton Street from Masonic Avenue to Stanyan Street.

Preparatory to widening of Stanyan Street along the east end of Golden Gate Park, the intersection at Frederick Street has been improved by purchase of a lot on the northwest corner and easing the curve in Frederick Street.

There have been no major changes of street widths during the year. Worcester Avenue was widened to a full 60 ft. between Vernon and Ralston Streets by purchase of a 30-ft. strip. The intersection of Lakeview and Capitol Avenues was improved by purchase of a triangular lot 25 ft. by 101 ft. on the southwest corner.

Plans are being prepared for widening the roadway of Marina Boulevard, which at present is 51 ft. in width. The curb on the northly side is now 29 ft. from property line. In this space there are an 8-ft. sidewalk and the track of the State Belt Line Railroad to the Presidio. The space occupied by the track is a serious encroachment on the parking area, which is at a premium on Sundays and special occasions.

The present plan is to move this curb back 9 ft. paving this area to make a total roadway width of 60 ft., thus adding one more traffic lane. The track will be moved to the center of a 12-ft. strip between the new curb and the existing 8-ft. sidewalk. The improvement will extend from Webster Street to the Presidio, a distance of 3600 ft.

Special Treatment Improvements:

Improvements which involve deviation from the ordinary methods are known as "special treatment improvements." Many of these are designed, but for various reasons, generally lack of funds, their construction is sometimes deferred for lengthy periods.

One of the more common situations requiring special treatment is the grading and paving of a street on a steep side hill, with a street or streets intersecting it in such a manner that under ordinary methods of design the grades would be too steep for satisfactory use, and access to the houses and garages on the two sides of the street would be impracticable on account of excessive difference in grade. These are treated generally by division of the street into an upper and a lower roadway with either a slope or a retaining wall between. These situations occur generally in districts where property values are relatively low, so every effort must be made to keep the cost of improvement proportionate to the value of the land. In many cases these improvements bring such benefits to the City in general that the Supervisors aid them by contributing from the general fund a portion of their cost.

Two of these projects, Castro between Twenty-ninth and Thirtieth Streets, and Holladay Avenue from Peralta Avenue to Adam Street, in which initial contracts were completed last year, are now ready for final paving contracts. Coso Avenue from Prospect Street to Winfield Street is complete. Laidley Street between Thirtieth and Noe Streets is under construction.

Street Lighting:

San Francisco is beginning to wake up to the fact that her street lighting facilities are far from modern, with the exception of those on a few outstanding streets. Under the present method employed, the installations, except those of the better character, are made by the Pacific Gas and Electric Company, which, under a year to year agreement, supplies power, service and equipment for lighting the streets. In addition to supplying the electric lights, the Company also supplies the gas lighting standards and the gas for lighting many miles of streets. Under such a short term agreement, the company naturally keeps its capital investment at a minimum. This has meant that the light installations in many districts are not in harmony with their surroundings.

Plans for the boulevards now under construction call for the furnishing and installing of a suitable lighting system. Iron pipe conduits are being installed on each side with proper provisions for later setting of street lighting standards. The type of lighting standards to be used has brought forth much discussion. The Board of Supervisors' Street Committee has not agreed to the selection of the standard made by the City Engineer and has been striving to secure control of this portion of the boulevard work. In the meantime, the construction of boulevards is progressing and some sections will be opened to traffic without street lights.

A number of districts have learned that under the Street Improvement Act, property owners may by petition secure through assessment a modern form of street lighting. The Lighting Committee of the Board of Supervisors has secured in the contract with the Pacific Gas and Electric Company for the coming year prices for serving installations not owned by the company. These prices are considerably lower than where the company supplies all of the equipment as well as service. This will permit a very marked increase in the illumination of districts willing to pay for their own equipment at no increase in cost to the City for the current and maintenance.

Following this procedure petitions have been presented for ornamental street lighting installations on Hyde Street, Jones Street, and Scott Street. These installations will be completed early during the coming year.

TRAFFIC: SIGNS AND MARKERS

Traffic Engineering:

The Traffic Division of this office, organized as described in the last annual report, has proved a useful adjunct. It participated in two safety campaigns in cooperation with the Traffic Law Enforcement Board, by assisting in planning the campaigns, giving radio lectures and talks at public gatherings on safety, writing portions of the matter used by public speakers, and preparing publicity material for the press.

The first campaign, known as the "Safe Summer Driving Campaign," was carried on from June to August, 1928. The second, the "Holiday Street Safety Campaign," was held during December, 1928. As a result of these campaigns and of various traffic control measures adopted, the public has awakened to traffic hazards, so that although the fatal accident rate has increased in California and in the United States, it has decreased in San Francisco from 26.3 deaths per 100,000 population in 1927 to 12.1 deaths per 100,000 for the first six months of 1929.

The activities of the division have been restricted, owing to scant personnel (four men) and insufficient funds. Traffic counts have been made, studies made and data filed relative to causes of traffic accidents, traffic ordinance changes drafted, recommendations made as to street improvements desirable to facilitate traffic, and studies made of numerous special traffic conditions. Many inspections have been required to investigate complaints of dangerous conditions.

Progress has been made toward securing adoption here of the United States Standard Street Traffic Signs, Signals, and Markings, as defined by national bodies working for such purpose. The adoption of such a standard system will be appreciated by the motoring public.

Plans and specifications were prepared for installation of conduit, signal bases and posts, signs, and traffic lanes for the boulevards which are being constructed under the recent bond issue. This work, which will cost about $40,000, is 50 per cent complete.

Plans for traffic control of Market Street, from The Embarcadero to Van Ness Avenue, included location of vehicular and pedestrian signals, location of safety zones, cross-walks, and safety islands, laning work and arrows, and relocation of some curbs. These plans, incorporated into a special report of the Traffic Law Enforcement Board, were later approved by the Supervisors' Traffic Committee. A traffic speed study was made to determine a time schedule for synchronizing signals on Market street.

The red reflector buttons originally installed at safety zones proved of little value, and were replaced by a new unit designed in this office, which has proved far more effective than the expensive, patented type. A suit for infringement of patent against the contractor who was furnishing the pedestrian lane markers resulted in the selection of a button better and cheaper than the patented article.

Investigation of illuminated arterial stop signs led to the adoption of battery type signs for intersections where stop and go signals were not installed, as being cheaper to install and operate than those receiving power from an outside source.

Contract let during the preceding fiscal year, for installing 60,811 pedestrian lane markers, at a cost of $4378.39, was completed in September, 1928.

Contract let on November 15, 1928, to E. J. Treacy, for removing and replacing various safety zone buttons and installing turning buttons and pedestrian lane markers, is incomplete, pending the appropriation of $1325 requested from the Supervisors on April 17, 1929.

Contract for placing conduit and cable, and wiring 500 arterial stop signs was awarded to R. Flatland on May 6, 1929, for the estimated amount of $33,641.64, but no appropriation of funds has been made by the Supervisors.

Street Signs:

A program of erecting and maintaining street signs, begun several years ago, is continuing systematically with appropriation of $10,000 annually. Two types of signs are used, known as Type "A" and Type "B". The former, as described in the last annual report, has four enameled iron name plates, while the latter has but one.

Since 1921, there have been erected by contract 3685 type "A" and 665 type "B" signs complete at a cost of $61,046. Maintenance crews under the Board of Public Works have installed 193 additional type "A" signs, have made all replacements and removals, and have done all necessary repainting. It is advisable to repaint all standards about once every two years. The aggregate cost of day labor work on street signs has been about $13,000.

With the $10,000 appropriation in prospect for the coming year, it is planned to erect 391 type "A" signs for which petitions have been filed, to place type "A" signs on all traffic signal boxes, and to do the usual amount of painting, repair, and upkeep. The installation of signs on traffic signal boxes will mean that nearly every downtown intersection will have four type "A" signs.

SPECIAL PROJECTS AND INVESTIGATIONS

Islais Creek Reclamation District is an area of 280 acres of swamp, mud, and tide land bounded roughly by Army, Iowa, Twenty-fifth, Third, and Islais Streets, Southern Pacific right-of-way, Quint Street, and Oakdale and San Bruno Avenues. Proceedings have been under way for some time to reclaim this area by filling behind rock walls. The cost of the development is estimated at $1,620,152, which is to be raised by assessment on the lands benefited.

As noted in the annual report for the preceding fiscal year, the assessment roll was confirmed by the Board of Supervisors by resolution signed by the Mayor in June, 1928.

On September 4, 1928, the property owners of the District held an election to determine whether to issue bonds to finance the work. In accordance with the Reclamation Act of the State of California, each owner is entitled to one vote for each dollar of assessed value of his land. The bonds were authorized by a vote of 387,700 affirmative and no negative votes out of 592,270 possible, but pending the adjustment of the claims of three objectors named in the last annual report, it was not considered advisable to issue the bonds.

Upon the advice of the attorney for the District, the trustees made settlement of the claims for damages of the Reinhart Lumber and Planing Mill Co. and Wm. Taaffe and Co. The claim of H. A. Whitley is not held to be legal. As all attempts to show this to Mr. Whitley have been unsuccessful, the claim will have to be adjudicated in court.

During the delay occasioned by these claimants, filling is being done under private contracts by many property owners and considerable progress is being made, although it would be much more rapid if done under District auspices.

Mr. M. H. Levy of this office is engineer for the District.

South Basin—South Basin Canal Reclamation District is the area comprising 988 acres, bounded by Hunter's Point, the bulkhead line, County line, and mean low tide line. It is proposed to organize a Reclamation District to build rock seawalls and fill these tidelands to make highly valuable industrial sites with rail and water connections. Material for walls and fill may be obtained by leveling 600 acres of Hunter's Point and pumping mud from the floor of the bay.

Estimate of cost of the work is:

Seawalls	$ 6,393,000
Fill 48,000,000 cu. yds.	4,300,000
Extensions to Main Sewers	300,000
Engineering, etc.	500,000
Total	$11,493,000

The cost per sq. ft. on lands and streets is 26.7 cents per sq. ft. or $11,630 per acre, but many persons think that the largest item of cost, that of seawalls, should be borne by the State through the Harbor Commission, which will, of course, be the recipient of all harbor tolls.

The project was discussed before numerous civic organizations and received the endorsement of the Industrial Committee of Chamber of Commerce, the San Francisco Real Estate Board, the San Francisco Building Trades Council, the State Building Trades Council, and the Civic League of Improvement Clubs. It failed to receive the endorsement of the Down Town Association. One of the most active members of this association, T. P. Andrews, is a large owner in the South San Francisco Dock Co., which has owned land in the District for about 70 years, but in that time has made no improvements. At all meetings, opposition to the reclamation plan centered in Mr. Andrews, or his assistant, Mr. Ainsworth, who was employed by the former to persuade owners in the District to oppose any plan for District development.

The Supervisors endorsed the project after numerous public meetings where both proponents and opponents had ample opportunity to state their views. A bill (Senate Bill No. 524, Session of 1929) was introduced in the Legislature to provide for organization of the District. After extensive modifications to meet the objections of the opposition, it was reported favorably by the committee on April 10, 1929, and on April 30, 1929, was passed by the Senate.

The bill was patterned closely after the Islais Creek enabling bill, whose legality had been established by Supreme Court decision. As finally passed by the Senate, it merely provided a means by which plans and investigations might be made at the expense of the City without any obligation on the part of the owners. After these definite plans were made they could proceed only if it were desired by the owners of more than 50 per cent of the area.

On May 7, 1929, the Senate bill was heard before the Assembly Committee on Commerce and Navigation and was tabled. It was supported by Assemblyman Williamson and opposed by Hornblower, Oliva, and Morrison.

The question will be introduced again at the next session of the Legislature unless in the meantime some method may be devised whereby the work may be started without organizing a Reclamation District.

San Francisco Bay Bridge:

The unsuccessful efforts of the City to obtain from Congress a permit to construct a bridge across San Francisco Bay to Alameda were narrated in the last annual report. At the time that hearings were had in Washington, the Senate Committee reported the bill favorably, the House Committee failed to report the bill, and Congress adjourned without taking action.

The open opposition which comes from the War and Navy Departments and in a lesser degree from some very wealthy shipping interests, we feel to be very short-sighted and extremely selfish. The departmental attitude is similar to the arbitrary position of the Department of Interior in the early stages of the City's applications for rights in Hetch Hetchy and Lake Eleanor in Yosemite National Park, but it is hoped that with a President from the West, who appreciates the urgent need for such a bridge, favorable action by the Federal Government may be expected in the near future.

The City's position has been strengthened materially by alliance with the State of California. Three bills passed at the last session of the Legislature are of vital interest. Senate Bill No. 538 provides that any bridge built across San Francisco Bay, connecting San Francisco and Alameda Counties, be made a part of the California State Highway System. Senate Bill No. 700 declares the policy of the State relative to toll bridges and creates a board to be known as the California toll bridge authority; authorizes the board to authorize the State Department of Public Works to build, purchase or otherwise acquire toll bridges, authorizes the board to issue revenue bonds for acquisition or construction of toll bridges, and to operate such bridges, etc., etc. Senate Bill No. 701 vests exclusive jurisdiction over toll bridges within the State in the Department of Public Works.

The State is determined to build the bridge. To that end a delegation of State officials, aided by San Francisco, will have a bill granting the necessary permit introduced early in the next session of the Senate. It is expected that the Secretary of War may decide of his own volition to issue the permit. Otherwise the fight will be pushed ahead in Congress until the desired permission is obtained.

Broadway Tunnel:

As noted in the last annual report plans were prepared for a tunnel under Broadway from Mason Street to Larkin Street. Estimated cost of this work was $1,500,000. It was proposed that the City provide $750,000 of this amount and that the remainder be obtained through formation of an assessment district of the properties to be directly benefited.

At the election of November 6, 1928, the proposal to issue $750,000 bonds as the City's contribution failed to carry, the vote being: For, 69,533; Against, 63,887.

Standardization of Construction Specifications:

During the last two years, this office has made exhaustive studies of specifications issued by various cities and other governmental subdivisions. These studies have resulted in the issuance of new Standard Specifications embodying the meritorious provisions of the various forms studied. The changes have improved the already high quality of the work designed and supervised by the office.

Atlas of Lands Owned by City:

In no department of the City is there a comprehensive atlas of City properties. Work has been begun on a compilation of records of these lands. The results of the work will be presented in atlas form, noting for each parcel the deed records, description, area, use to which put, etc.

Garbage Disposal:

The City's garbage and refuse are disposed of at present by incineration in a destructor owned by the City, located at Sixteenth and DeHaro Streets. The combustible matter is not completely consumed, and the plant is conceded to be inadequate, obsolete, unsanitary and generally unsatisfactory. This condition has existed for several years.

Suit was brought against the City and the Scavengers' Protective Association by persons of the neighborhood, styling themselves San Francisco Development Company, to obtain relief from the unpleasant conditions. This action, No. 174,187, was filed in the Superior Court on October 4, 1926. The City's demurrer, filed November 15, 1926, was overruled January 7, 1927. The action was heard before Judge Edmund P. Mogan on May 17, 1929. On June 5, 1929, the Judge decided that the "incinerator" is a nuisance and should be replaced by a modern plant. Pending its construction the Court suggested that the "fill and cover" method of disposal be resorted to. The Supervisors were allowed 60 days in which to take the necessary action toward construction of a new plant. Formal judgment will be entered later.

Prior to 1896 garbage collection and disposal was handled by independent scavengers who received but little official attention. The refuse collected was used in filling low or marsh areas. Combustible refuse in the dumps was burned by scavengers who sorted over the material searching for junk. In February, 1896, when the most available dumping spaces had been filled, the Supervisors granted to F. E. Sharon a 50-year franchise for disposing by incineration of all the City refuse.

In 1897 the Sanitary Reduction Works, successors in interest to Sharon, erected a destructor on the block bounded by Rhode Island, DeHaro, Alameda, and Fifteenth Streets. Ordinances passed by the Supervisors provided that all refuse be delivered to the destructor and that the Company be paid 60 cents per ton by the scavengers for all refuse so delivered.

In 1908 the voters authorized a bond issue of $1,000,000 to purchase the franchise and properties of the Sanitary Reduction Works and to build two or more modern incinerators in different portions of the City. Under the advice of a prominent sanitary engineer of New York, engaged as consulting engineer, specifications were prepared for two high temperature incinerators of most modern type. In November, 1910, contracts for two such incinerators were let to Destructor Company of New York.

The present City Engineer was appointed on September 1, 1912. His knowledge of the type of incinerator being erected under the contract led him to apprehend that operation might not be successful on account of the difference in constituents of the refuse here and in the East. The contractor was required to complete the first incinerator and demonstrate its success before the second one should be built. The test made by the contractor in September and October, 1914, did not prove that the incinerator could meet the contractor's guarantees so the Board of Public Works refused to accept the plant. The contractor appealed to the courts and won judgment on the plea that the guarantees did not mean exactly what they said and the contractor had done the best that he could.

In 1909 the City had purchased the franchise and properties of the Sanitary Reduction Works. This purchase was completed in 1918 for a total payment of $400,000. The Scavengers' Association operates the plant and receives one dollar per ton for all refuse received and incinerated. About 15,000 tons of unsegregated refuse are handled monthly. The unconsumed residue, cans, ashes, clinker, etc., amounting to 25 per cent of the total, is hauled by railroad to convenient dumping grounds and is used in making fill.

There is no segregation of refuse into garbage and rubbish except that many hotels and restaurants separate the table and kitchen wastes for sale to hog raisers. Collection of these wastes amounting to some 2000 tons monthly and selling at $3.00 or more per ton is made by other than the regular refuse scavengers and constitutes quite an industry. Each scavenger and each wagon is licensed annually by the City. Scavengers operate as individuals, although practically all of them are associated with either the Scavengers' Protective Association or the Sunset Association, which are organized for systematic and economical collection of the refuse.

On account of the scavengers operating independently and being under limited control of the City there have been many complaints of inequality of charges. In December, 1921, the Supervisors passed an ordinance limiting the amount of charges for collection of refuse and authorizing the Board of Health to enforce it. On June 14, 1927, an initiative proposition carried by a majority of the voters, established regulations for the collection and disposition of refuse and set monthly rates for the service.

The destructor now in use is unsatisfactory in many respects. Its design is obsolete and its physical condition is such that to rehabilitate it would require rebuilding of the entire plant except possibly the chimney.

In an attempt to use the incinerator on Army Street, which the City acquired as a result of the Court's action in the Destructor Company's suit, at the request of the Health Committee of the Board of Supervisors this office made plans and estimates for an incinerator on that site, to handle 700 tons per day. This recommmendation was approved March 14, 1928, and transmitted to the Supervisors. The Health Committee, on April 5, came to no agreement. On April 24 a public hearing was held, many protests were received, alternative measures were discussed, and no action was taken.

Dumping at sea has often been discussed. In February, 1927, at the request of the Supervisors, this office prepared plans and specifications for collection and disposal of refuse by this method. These were duly approved by the Board of Public Works and transmitted to the Supervisors. In April, 1927, estimated costs of four alternative locations for refuse loading stations were likewise approved and transmitted. On September 15, 1927, the Health Committee directed the City Engineer to prepare specifications and proposals for disposal by dumping at sea. On October 5, 1927, the report was approved and transmitted. During 1927 many proposals for such disposition were received, but no action has been taken.

Sanitary fill has been suggested as a temporary measure. In this method the contractor would be required to dump all refuse in certain tide land and low-lying ground areas, to keep the dump free from rodents, vermin, and flies, and in as sanitary condition as possible by totally covering each day's fill by an equivalent amount of earth. Property owners and residents in the vicinity of the proposed fill areas were emphatic in their objection to this method. The Board of Health and the City Engineer stand opposed to such method except as a temporary expedient, as constituting a serious menace to the life and health of the community. Not alone would it adversely affect commerce and industry but would entail serious economic loss and tremendous cost of eradication in the event of plague infestation.

In May, 1928, Chairman Toner of the Health Committee toured the East for about a month. He visited a number of disposal plants but made no detailed report of his observations.

On September 26, 1928, the Health Committee held another public meeting similar to the one of April 24. Again no action was taken.

On October 8, 1928, the Health Committee obtained 60 days' leave of absence and an appropriation for expenses to visit various incinerators. They were not accompanied by a qualified engineer because as one of the committee remarked: "We do not want to be hampered." On November 5, 1928, the chairman of the committee reported to the Supervisors, noting the cities visited, methods of disposal used, and the types of incinerators and asked for 90 days in which to prepare final recommendations.

On April 24, 1929, the report was read at a meeting of the Health Committee and was approved. It was presented to the Board of Supervisors April 29, 1929. At this meeting it was moved that the City Engineer and assistant visit and examine the new incinerator in Chicago, but the motion was lost.

The Committee's report recommends incineration at a plant of patented type, to be built on the present site at Fifteenth and DeHaro Streets; this to be constructed and operated by the municipality; during the construction period, disposal to be by the fill and cover method in the area south of Hunter's Point; the City Engineer to prepare plans and specifications for the recommended type of incinerator; the City Attorney to prepare the necessary legislation; and the Finance Committee to provide $1,000,000 for construction. The report was discussed acrimoniously and at great length in the Supervisors' meetings of May 6, 13, 20, and 24, and June 3 and 10, the principal objections being from the clique which is advancing the fill and cover method of disposal.

On June 10, 1929, the Board of Supervisors passed Resolution 31004 (New Series) which was approved by the Mayor on June 13, declaring their policy to be:

1. Incineration to be adopted.
2. Steps to be taken for construction and operation of an incinerator adjacent to the present site.
3. Incinerator to be municipally owned, constructed and operated.
4. City Engineer to be requested to tour eastern cities to determine best type of incinerator to be recommended to the Board.

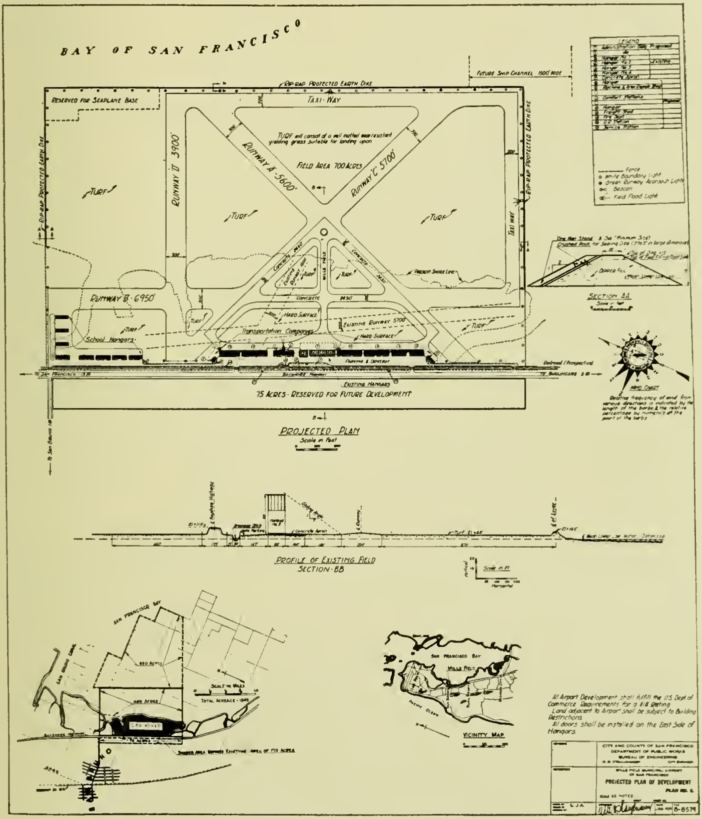
The City Attorney was directed to prepare legislation for a bond election at the earliest practicable date, for construction of an incinerator.

On June 28, 1929, the City Engineer, accompanied by W. H. Ohmen, Assistant Engineer in charge of design, left San Francisco for a tour of incinerator investigation. They returned on July 16.

STRUCTURES AND MISCELLANEOUS CONSTRUCTION

San Francisco Municipal Airport:

Operation of Mills Field, San Francisco Municipal Airport, continues generally in a satisfactory manner, although its development and the construction of necessary facilities have been retarded by lack of funds.



Projected plan of development
MILLS FIELD, SAN FRANCISCO MUNICIPAL AIRPORT

It is managed and its policy dictated by the Airport Committee of the Board of Supervisors. Design and construction are under the City Engineer.

Since the field has been established, 35,191 flights and landings have been made and 57,866 passengers have been carried. In June, 1929, there were 2281 flights as against 1298 in June, 1927. The number of planes at the field in June, 1929, was 37, as against 23 in June, 1928.

The 1929-30 budget includes an appropriation of $160,000 for development of the airport. There is crying need for additional hangar space, as well as additional drainage, macadam surfacing and other items.

An inadequate drainage system, due to tardiness of the Supervisors in providing funds for the work, resulted in some unpleasant newspaper notoriety when Colonel Lindbergh refused to taxi an extremely heavy airplane over a soft spot in the field. From the resultant cloud of criticism and comment, some constructive ideas seem to have come.

The Supervisors' Airport Committee on April 5, 1929, requested that an Airport Advisory Committee of disinterested citizens be formed to assist them. The new committee was to consist of an army officer of rank greater than major of the Flying Corps; a pilot holding a Department of Commerce Transport license; and a business man. As a result there were appointed Wm. G. Marvin, retired capitalist; E. E. Mouton, Aeronautics Inspector for the Department of Commerce, and Lt. Col. Gerald C. Brant, Commandant of Crissy Field.

The location, meteorological conditions, and topography of Mills Field are ideal for an air base. For passenger and mail service, however, to avoid delay, there should be in addition a terminal close to the heart of the City. Crissy Field, near the Marina, could well be developed for this purpose.

A plan for future development of Mills Field has been prepared by this office. The estimated costs of the items are as follows:

MILLS FIELD, MUNICIPAL AIRPORT
Hangars 2, 3, and 4

Purchase of 1595 acres	$ 411,000
12,600 lin. ft. of riprap protected earth dyke	428,400
10,100,000 cu. yds. of hydraulic fill	1,010,000
21,000 lin. ft. of water-bound macadam runways	189,000
8,800 lin. ft. of hard surface runways	176,000
6,800 lin. ft. of taxi-ways	40,800
Artificial drainage of 620 acres	155,000
Leveling and sodding of 550 acres of reclaimed area	82,500
Construction of 230,000 sq. ft. of hangars and shops	644,000
Administration building, furnishings and equipment	100,000
Lighting	192,000
Two comfort stations	8,000
21,000 lin. ft. of fence	21,000
850,000 sq. ft. of roads and parking area	68,000
510,000 sq. ft. of hard surface aprons	102,000
Total	$3,627,700
Engineering and contingencies	372,300
Total	$4,000,000

At the election of November 7, 1928, a proposition was submitted to the voters to authorize the issuance of $1,700,000 to finance the first steps of this program. The bond issue failed to receive the necessary two-thirds vote, the canvass showing: For, 75,993; Against, 59,354.

The system of meteorological observations at the field is excellent. At intervals of 1½ hours during the daylight hours a record is made of wind direction and velocity, state of the weather, amount and type of clouds, height of ceiling, visibility, temperature, and atmospheric pressure. Pilot balloon observations are taken daily except Sundays and holidays.

A weather report is prepared for each transport pilot for the hour of his scheduled departure. This indicates the factors affecting flying, not only at his point of departure but at several stations along the route. At 7 A. M. a weather chart is issued, showing conditions over the San Francisco-Los Angeles Airway. At 7:30 A. M. a wall map is prepared showing conditions from Seattle to Los Angeles and from San Francisco to Reno, Nevada. At 8:30 A. M. a map is made showing general weather conditions over the United States, Canada, Alaska, and the Pacific Ocean.

Typewriter printers are used for transmission of weather reports and for dispatching the movements of transport planes. All messages received by the Department of Commerce radio operator at Concord are placed on the tape and the San Francisco Weather Bureau Office twice daily relays weather reports from stations in the United States, Canada, Alaska, and from vessels in the Pacific Ocean.

Weather reports are received every 1½ hours from 6:30 A. M. to 3:30 P. M. from 40 stations between San Francisco and Los Angeles. Reports are received twice daily on air conditions in California, Oregon, and Washington and from five stations in nearby states.

Two contracts for improvement of the airport were let during the year. Contract 11 was for installation of part of the drainage system, and for grading of a portion of one of the main runways included in the general scheme of development. This contract was awarded October 15, 1928, to Meyer Rosenberg for the estimated amount of $42,261.35 and was practically completed in February, 1929. It included the furnishing and laying of 31,406 ft. of drain tile, vitrified pipe, and perforated asphalt dipped corrugated steel pipe, ranging in size from 4 in. to 18 in. dia. Final payment and acceptance are being withheld pending adjustment of the City's claims for damage and loss of electrical cable destroyed by the contractor. The work done under the contract did much to correct the muddy condition of portions of the field, for which the Airport Committee of the Board of Supervisors has been so much criticized, but the drainage work is not yet complete.

Contract 12, for grading (filling of depressions), was awarded to Meyer Rosenberg, April 24, 1929, for the estimated sum of $2103 and at the end of the fiscal year had been practically completed.

A few of the interesting events at Mills Feld during the fiscal year are noted below:

July 14, 1928—National Air Tour planes arrived. Fleet consisted of 26 ships, which stopped at 32 cities and covered 6500 miles.

August 2, 1928—Capital Air Lines inaugurated Air Service to Sacramento.

September 11, 1928—Air Derby to Mines Field, Los Angeles, a race by 18 ships. Winner's time, 3 hrs. 10 min.

September 30, 1928—Boeing plane of Pacific Air Transport Co., carrying mail from Los Angeles to Oakland, forced to land at Mills Field on account of heavy fog on east side of bay.

November 4, 1928—Boeing tri-motored plane carrying 12 passengers from Cheyenne, Wyoming, to east bay ports, forced to land at Mills Field on account of fog conditions on east side of bay.

May 11, 1929—Monterey and Bay Cities Flightway inaugurated air service between Mills Field, Oakland Airport and Monterey.

May 12, 1929—Pickwick Airways, Inc., inaugurated service, daily except Sundays, to Los Angeles.

Auxiliary Water Supply (High Pressure) System:

Extension No. 7 of this system involved the laying of 18-in. pipe on Franklin and Grove Streets, a distance of 830 ft., and the removal of similar pipe in Fulton Street from Van Ness Avenue to Franklin Street, which has been closed as part of the development of the long talked of War Memorial.

Contract for the work was awarded September 21, 1928, to E. J. Treacy for the estimated amount of $16,461.62. After many trying delays the work was finally completed in April, 1929.

New pipe was purchased for this work. After the customary inspection on the Atlantic Coast it was inspected on arrival in San Francisco and tested in the plant at the Municipal Pipe Yard at Seventh and Hubbell Streets, which was put into operating condition for this purpose.

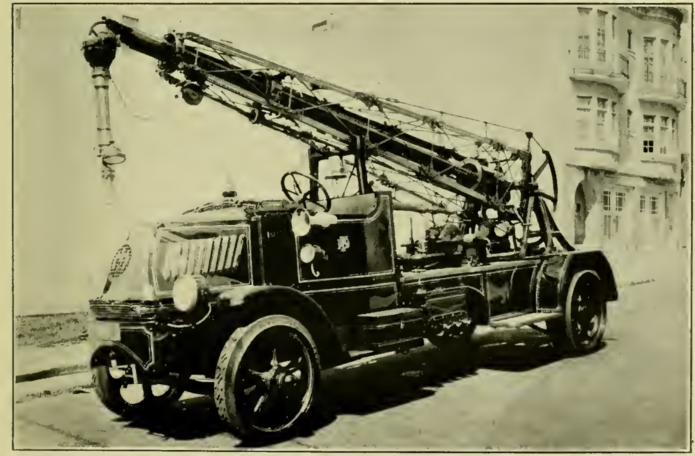
Detail plans and specifications were prepared for a line to afford fire protection to the recently completed Kezar Stadium in Golden Gate Park. This line was designed under standard conditions for high pressure service, although the present connection is to be off the domestic water supply system, keeping in mind the possible future extension of the high pressure system into the Sunset District.

At the request of the Fire Department, estimates of cost of extensions were made as follows:

> 10-in. pipe on Filbert Street, from Kearny to Montgomery; 11,433 ft. of 16-in. and 12-in. pipe in the Potrero District; 16-in. and 12-in. pipe from Army Street and Evans Avenue to Twenty-third and Third Streets; Laguna Street from Market Street to Golden Gate Avenue; Hayes Street from Fillmore Street to Van Ness Avenue; and a system of 8 mi. of 16, 14, 12 and 10-in. pipe in the Marina District.

Water Tower:

Among the miscellaneous designs made by this office was that of a 30-ft. water tower for the Fire Department. Total weight of this equipment is 22,000 lbs.; length, 22 ft.; width, 7 ft. 6 in.; height, with tower at rest, 10 ft.; height to extended center of tower nozzle, 30 ft.



FIRE DEPARTMENT EQUIPMENT DESIGNED IN CITY ENGINEER'S OFFICE
30-FOOT WATER TOWER

It has eight 3-in. inlets, 4-in. deck monitor battery with 2¼-in. nozzle and 4-in. mast monitor head with 2⅝-in. nozzle. In test it delivered 2638 gallons per minute at 115 lbs. pressure from the tower alone. With deck and tower together, delivery was 1750 g.p.m. at 135 lbs. from deck, and 204 g.p.m. at 115 lbs. from tower. The body is ballasted so that the streams of water may be discharged while the truck is in motion.

The tower, monitor battery, water wheel, manifold and piping were installed by contract on a truck chassis. The water operating mechanism, electrical work, ballasting, etc., were designed, constructed, and installed by the Corporation Yard of the Fire Department. Total cost is $19,000.

Municipal Water Works:

On account of the delay in taking over operation of the Spring Valley Water Company's system, the Municipal Water Works continues to function individually. Three extensions of mains were made during the year, 300 ft. of 8-in. pipe along the west side of Third Street at Bay Shore Boulevard intersection, 2-in. pipe in Goettingen Street to Rodeo Avenue, and in Teddy Avenue to Rodeo Avenue. Several mains were relaid to allow of street and boulevard construction.

An increase in consumers averaging six monthly has brought the total number to 1000.

The force pump which lifts the water from the wells to the reservoir, has been in service for over 20 years, and this year required extensive overhauling. Its delivery was increased by change of pulley ratios. Unsatisfactory operation of the signal system between reservoir and pump station, due to old, corroded wires, was corrected by replacement of wire in portions of the line. Repairs were necessary on the roofs of the reservoir and the tank.

During the year the draft from the well was approximately 160,000 gallons daily, during which time the depth from ground to water surface fluctuated between 33.4 and 35.3 ft. Pumping time averaged 15 hours daily. Peak consumption was in May, 1929, when 194,250 gallons were pumped from the well and 15,750 gallons were purchased.

Operating statistics are shown below:

	1927-1928	1928-1929
Water pumped from well, gallons	49,377,250	48,440,750
Water purchased—gallons	11,252,250	6,443,250
Water pumped to reservoirs, gallons	60,629,500	64,884,000
Capital expense	$12,517.02	$ 3,631.95
Operating expense	$18,815.12	23,630.41
Total income	$31,332.14	$27,262.36
Loss	147.17	658.32
Total expenditures per 1,000 gals	0.517	0.420
Total operating expense per 1,000 gals	0.310	0.364
Total income per 1,000 gals. pumped to res	0.308	0.354

The private water company receives $3.00 per month per hydrant for water use, under rates established by the State Railroad Commission. The Municipal Water Works has been uniformly unsuccessful in attempting to collect similar charges approximating $2,100 annually, from the Fire Commission.

On January 12, 1928, the Board of Public Works on recommendation from this office, cooperating with the Fire Commission and civic organizations, requested the Supervisors to appropriate $5500 for the construction of a main with hydrant connections, on Third Street, Key Avenue, and Jennings Street. A similar request was made on August 27, 1928, for an extension on Silver Avenue. The request was reiterated on January 18, 1929. Both requests were again put before the Supervisors in hearings for the budget for 1929-1930, but they failed to make any appropriation. The situation is critical and fire protection is urgently needed in these districts.

Bridges Within the City:

The City maintains and operates or has under construction a number of bridges, the more important of which are tabulated below:

BRIDGES IN SAN FRANCISCO

Location	Type	Length & Width, ft.	Service	Year Built	Approx. Cost
Third Street at Channel	2-leaf Page Bascule	113x51	Vehicular & St. Ry.	1904	$110,000
Fourth Street at Channel	Strauss Bascule	94x61	Vehicular	1917	112,300
Sixth Street at Channel	Draw, Pivot Swing	2 openings 58x20	Vehicular	1888	27,000
Third Street at Islais Crk.	Strauss Bascule	105x46	Vehicular Stm.& El.Ry.	1915	213,700
Beale Street at Harrison St.	Steel Girder	82½x35	Vehicular & St. Ry.	1913	34,500
Mission Street at Alemany Blvd.	Concrete	908x82½	Vehicular & St. Ry.	1912	210,600
San Jose Ave. at Mt. Vernon Ave.	Concrete	697x107	Vehicular & St. Ry.	1926	103,600
Evans Ave. at Army Street	Timber	103x36	Vehicular	1926	5,300
Highland Ave. at Bernal Cut	Concrete	206x40	Vehicular	1929 *	35,330
Richland Ave. at Bernal Cut	Concrete	235x40	Vehicular	1929 *	37,668
Bosworth St. at Bernal Cut	Concrete	108½x121	Vehicular Stm.& El.Ry.	1929 *	174,744

*Under construction.

Operating personnel of the movable bridges is under the Superintendent of Public Buildings, who is responsible also for ordinary maintenance such as painting, running repair of machinery, etc. Major repair is done by contract, the plans, specifications, and inspection being done by this office. Occasional damage is done the movable bridges by improper handling of ships or by other accident. In such cases this office appraises damages and formulates plans for repair.

A movement is now under way to replace the bridge at Third and Channel Streets. The depth of water at this bridge is now 23 ft. which is not sufficient for large ships. The bridge was received in 1906 from the Santa Fe Railroad as part of a franchise requirement. The top of the pier on the south side of the channel has been slowly moving northward. This movement appears to have been checked by the repair work described in the last annual report and by the placing of 5 ft. by 5 ft. struts beneath the water. It is these struts that limit the draft to 23 ft.

The Board of State Harbor Commissioners is anxious to extend the Belt Railroad southerly across the Channel but the present bridge was not designed to carry heavy locomotives and freight cars. The estimated cost of a new bridge is $550,000 and both the Harbor Board and the Board of Supervisors have expressed their willingness to contribute $150,000 each toward the new construction. In June, 1929, an effort was made to obtain contributions for the remaining $250,000 from the Southern Pacific and the Santa Fe Railroad Company that would gain substantial benefits from the erection of a new structure, but both companies declined to assist. It will now be necessary to form an assessment district, to which these companies must contribute, to finance the work.

In view of the probability of early replacement of the bridge, no extensive maintenance work is contemplated. However, it was absolutely necessary to refloor it, which was done by day labor forces of the Board of Public Works at a cost approximating $6,000. Beale Street Bridge was repainted and minor electrical repairs were made on the mechanism of the Third Street Bridge at Islais Creek.

SEWERS

Bond Issue:

The last annual report cited a number of districts served by inadequate or defective main sewers, among them being the old valley of Mission Creek extending from the Fillmore Street district past the Civic Center to Tenth and Market Streets, the vicinities of Fourteenth, Market, and Church Streets, and of Geary Street and Twenty-third Avenue, portions of the "south of Market district," and also the Islais Creek valley. To provide satisfactory drainage of these areas this office recommended the construction of concrete sewers at an estimated cost of $2,200,000. This proposition won the approval of the voters at the election of November 6, 1928, when by a vote of: Yes, 88,448; No. 41,782, they authorized the issuance of bonds in the amount indicated.

On account of the poor condition of the bond market no attempt has been made to sell any of these bonds. The construction of Section A of Alemany Boulevard cannot be undertaken until after the completion of a sewer along its length, at an estimated cost of $485,000 which will be paid out of bond funds. It was therefore decided to put on the market $500,000 of bonds on July 22, 1929, to complete this work and allow the continuation of boulevard construction.

The main sewer system is still a long way from completion but construction of the items made possible by this bond issue should carry us along for a few years. The system at present consists of 92 miles of trunk sewers built by the municipality at a cost of over $15,000,000, exclusive of the cost of ordinary sewers which are installed by private contract at the expense of owners of abutting property. Within the next 15 years it will be necessary to expend about $12,000,000 for construction of additional main sewers.

Work planned under the recent bond issue is as follows: Alemany Sewer as noted above, 3623 ft. long, 8 ft. 6 in. by 12 ft. and 8 ft. 1½ in. by 10 ft. 3 in.; Fillmore Street Sewer, 11,305 ft. long, varying from 6 ft. 9 in. to 5 ft. 3 in. circular and 3 ft. 6 in. by 5 ft. 3 in. egg shape; Fifteenth Street Sewer, 5289 ft. long, 8 ft. 6 in. to 6 ft. circular and 3 ft. by 4 ft. 6 in. egg shape; College Hill Tunnel, 6460 ft. long, 4 ft. by 6 ft. 6 in.; and the Twenty-third Avenue and Geary Street Sewer, 3070 ft. long, ranging from 4 ft. by 6 ft. to 2 ft. by 3 ft. egg shape.

Plans and specifications are complete for the major items of this bond program and are being prepared for the smaller units.

Current Construction:

All of the sewer construction noted as in progress in the last annual report has been completed. The Wawona Street sewer and the Thirtieth Avenue sewer have made building possible in large residential tracts. Completion of Laguna Honda Boulevard sewer was followed immediately by beginning of construction of the boulevard. The first unit of the Fillmore Street sewer was completed in October, 1928, using funds appropriated in the annual budget. The remaining units will be constructed out of bond funds. Main sewers being laid in Golden Gate Heights by forces of the Side Sewer Department under inspection by this office have been practically completed. Final report is not yet made but about 33,000 ft. of 12 in. and 8 in. pipe with all necessary appurtenances have been installed at a cost of about $80,000. Preparation for the proposed War Memorial Buildings in the Civic Center necessitated construction of 2 ft. 6 in. by 3 ft. 9 in. concrete sewer in Franklin Street from Fulton Street to Grove Street.

A small sewage pumping station was erected at Fitzgerald Avenue and Griffith Street. The pump is vertical, single stage, centrifugal with 4 in. discharge to 55 ft. head. It is run at 200 r. p. m. by 15 horse power motor. Pumpage is from a low-lying area along the bay shore into Bay View main sewer. Two similar units are being installed at Seacliff to pump from a small area at China Beach into Baker's Beach outfall sewer.

Plans for sewerage systems in the following tracts were investigated and approved by this office: Westwood Highlands No. 4, Geneva Terrace, Seacliff Extension, McLaren Terrace, and Homestead Manor.

Side Sewers:

The policy of having side sewers constructed along with main sewers, as noted in the last annual report, has resulted in further decrease in the number of side sewer permits issued from this office. Applications for such permits were distributed over the months as follows:

	Number Applications	Amount Collected
1928:		
July	88	$ 6915.75
August	117	8248.75
September	88	5922.75
October	110	9199.50
November	102	7059.50
December	84	5963.50
1929:		
January	99	6720.50
February	76	5520.50
March	71	4942.50
April	86	5570.00
May	81	5466.25
June	69	4646.75
Totals	1071	$76,176.25

STREET WORK PERFORMED UNDER CONTRACTS
July 1, 1928, to June 30, 1929

	Quantity	Cost
Asphaltic Concrete Pavement:		
8″ concrete base, 1½″ wearing surface, 1½″ binder	86,061 sq. yds.	$237,692
8″ concrete base, 2″ wearing surface, paint coat	13,088 sq. yds.	36,875
6″ concrete base, 1½″ wearing surface, paint coat	405,849 sq. yds.	1,076,849
6″ concrete base, 1″ wearing surface, 1½″ binder	16,163 sq. yds.	36,362
3½″ black base, 1½″ wearing surface	5,118 sq. yds.	11,695
2″ wearing surface on existing base	6,956 sq. yds.	5,282
10″ macadam base, 2″ wearing surface	109,614 sq. yds.	138,114
8″ macadam base, 2″ wearing surface	822 sq. yds.	1,258
Reinforcing mesh in concrete base	3,564 sq. yds.	1,283
Asphaltic Surface—conform & misc.:		
2″ wearing surface, conform	737 sq. yds.	647
2″ wearing surface, misc. conform	—	3,715
Miscellaneous	—	7,874
2″ wearing surface on basalt blocks	81 tons	644
Asphaltic Binder	202 tons	1,714
Basalt Block Pavement—relaid	98 sq. yds.	88
Brick (Vertical Fibre) Pavement	3,342 sq. yds.	11,348
Concrete Pavement—6″	63,891 sq. yds.	137,658
Macadam Pavement:		
8″ waterbound macadam	7,919 sq. yds.	6,122
8″ oiled macadam	2,282 sq. yds.	1,643
4″ waterbound macadam	1,769 sq. yds.	478
Macadam rock spread	1,350 cu. yds.	1,809
Curb:		
Granite, reset	3,703 lin. ft.	1,447
Concrete, new	215,748 lin. ft.	204,915
Concrete, reset	5,247 lin. ft.	2,534
Curb and Gutters, concrete	3,705 lin. ft.	4,817
Gutters, concrete	9,766 sq. yds.	25,394
Headers, redwood, 10″ and 8″	45,069 lin. ft.	3,933
Sidewalks, artificial stone	52,488 sq. yds.	76,735
Stairways, concrete	7 only	850
Concrete	52 cu. yds.	1,383

Street Work Performed Under Contracts—Continued

	Quantity	Cost
Subways, concrete	2,284 cu. yds.	46,688
Reinforcing steel	143 tons	8,052
Lighting and drainage	—	2,594
Walls, concrete	1 only	660
Concrete	958 cu. yds.	24,302
Rubble	—	1,737
Misc. concrete in walls and stairs		3,024
Reinforcing Steel in walls and stairways	95,976 lbs.	3,401
Bulkheads and Stairways, wood	—	1,476
Pipe Railing	347 lin. ft.	764
Warning Lights and Reflectors	22 only	544
Conduit & Electrical Fixtures:		
2½″ blk. pipe	3,823 lin. ft.	2.867
2″ blk. pipe	8,517 lin. ft.	6,592
1½″ blk. pipe	39,194 lin. ft.	18,879
Junction and pull boxes, etc.		3,077
Fence, miscellaneous		265
Grading, cut:	494,703 cu. yds.	349,698
Fill	275,984 cu. yds.	93,476
Misc.		11,435
Piles, wooden	65,216 lin. ft.	47,782
Sewers, reinforced concrete:		
8′ 6″ x 11′ 0″—2 compartment flat top	484 lin. ft.	18,876
6′ 9″ circular	1,172 lin. ft.	37,510
3′ 6″ x 5′ 3″ egg shaped	1,320 lin. ft.	28,457
3′ 0″ x 4′ 6″ egg shaped	1,618 lin. ft.	20,704
2′ 6″ x 3′ 9″ egg shaped flat top	924 lin. ft.	8,969
2′ x 3′ egg shaped flat top	6,768 lin. ft.	51,198
Tapers, junctions, and spillways	6 only	1,115
Sewers, ironstone pipe:		
24″ dia., in concrete	155 lin. ft.	2,073
21″ dia.	2,865 lin. ft.	6,339
18″ dia.	4,854 lin. ft.	16,865
15″ dia.	14,270 lin. ft.	24,810
12″ dia.	22,496 lin. ft.	46,656
10″ dia.	76 lin. ft.	152
8″ dia.	43,008 lin. ft.	98,096
6″ dia. side sewers	91,824 lin. ft.	96,962
Sewers, 18″ wood stave pipe	49 lin. ft.	147

Street Work Performed Under Contracts—Continued

	Quantity	Cost
Y-branches:		
On 21″ dia. sewers	90 only	120
On 18″ dia. sewers	151 only	244
On 15″ dia. sewers	186 only	344
On 12″ dia. sewers	735 only	962
On 10″ dia. sewers	2 only	2
On 8″ dia. sewers	2,648 only	4,410
Manholes:		
On concrete sewer	54 only	5,470
On ironstone pipe sewer	351 only	41,256
Rebuilt	5 only	490
Lampholes	1 only	50
Catch Basins:		
New	464 only	52,868
Reset	64 only	3,315
Repaired	—	699
Storm Water Inlets	68 only	5,216
Culverts, 10″ ironstone pipe	19,707 lin. ft.	27,399
Underdrains, ironstone pipe:		
12″ dia.	972 lin. ft.	97
8″ dia.	1,008 lin. ft.	605
Miscellaneous Sewer and Drainage Work		7,290
Total		$3,278,237

Summary—Cost of Street Work:

Public Contracts	$ 284,004
Private Contracts	1,838,862
City Pay	1,155,371
TOTAL	$3,278,237

STREET IMPROVEMENT ASSESSMENTS, ETC.

Assessments and Bonds for Street Work:

Assessments issued for cost of street work performed	98
Cost of street improvements covered by assessments	$383,965.84
Bonds prepared (in triplicate)	162
Amount of assessments guaranteed by bonds	$ 52,371.22
Average amount guaranteed by each bond	$ 323.25

Street Work Proceedings

Resolutions of Intention passed	52
Street improvements recommended under Res. of Intention	137
Notices of street improvements posted	2,304
Notices of Resolution of Intention mailed	2,383
Ordinances ordering performance of St. Impvts. passed	133
Proposals of street improvements published	144
Public contracts for street improvements awarded	100
Private contracts filed	290

Public Proceedings for Sidewalks:

Contracts formulated	57
Surveys made	42
Examination sheets made	33

Notices, Permits and Investigations:

Notices to construct and repair sidewalks	2,618
Notices to construct bulkheads	452
Notices to remove obstructions	2,654
Notices to obtain curb lowering permits	447
Notices to construct guard rails	19
Notices to obtain oil tank permits	124
Notices to reconstruct side sewers	71
Notices to obtain street space permits	1,070
Street space permits reported on	3,654
Oil tank permits reported on	524
House moving permits reported on	128
Miscellaneous calls and investigations	3,419
Blasting bonds set and jobs supervised	45

Permits and Fees for Corporation Trenches and Main Line Extensions:

	Service Connections	Mains Lineal Ft.	Fees
Pacific Gas and Electric Co	3,401	26,835	$ 5,331.00
Spring Valley Water Co	2,854	82,919	4,944.00
Pacific Telephone & Telegraph Co.	535	48,310	1,215.00
Great Western Power Co	121	15,340	315.00
Western Union Telegraph Co	10	315	18.00
Postal Telegraph Co	4	....	6.00
	6,925	173,719	$11,829.00
*Special Deposits			4,388.00
Total			$16,217.00

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*Permits granted for which special deposits were made, to move steam shovels and tractors, to repair or install oil tanks, service pipes, fire alarm wires, cables, and conduits, to lower curbs, etc.

SURVEYS

Surveys Performed:

For public contracts	64	
For private contracts	453	
Resurveys for contracts	193	
For municipal departments	358	
Total for public improvements		1,068

Lot Surveys:

For private owners	20	
For municipal departments	4	
Total lot surveys		24
Total surveys		1,092

Surveys include approximately 1783 blocks and crossings, a total of 478,000 ft. or about 90 mi., in addition to about 50 mi. of highway and monument lines and the placing and replacing of 185 monuments.

Surveys were also made in connection with the Municipal Airport, Golden Gate Heights sewers, Bernal Cut, Islais Creek Reclamation District, Kezar Stadium and Portola Drive, in addition to various tests in subsiding areas.

The highway surveys include the Junipero Serra Widening from Ocean Avenue to the County Line, Junipero Serra Extension from the County Line southerly to Burlingame, Nineteenth Avenue Extension from Sloat Boulevard to Junipero Serra Boulevard, Ocean Avenue Extension, Bernal Heights Boulevard, Bay Shore, Alemany, and the Sunset Boulevards.

Precise Levels and Bench Marks:

New bench marks established and old bench marks checked and reestablished:

District	Bench Marks	Distance Miles
Golden Gate Heights	194	7.60
Sunset	284	8.60
Crocker Amazon	112	4.00
University Mound	37	1.10
City Land	89	2.60
Ocean View	77	3.20
100 Vara	430	11.40
Western Addition	132	4.40
Mission	1,033	28.40
Other districts	458	11.50
Total	2,846	82.80

Maps Approved and Recorded:

1. Noriega Street, Thirty-first Avenue to Forty-eighth Avenue (widening).
2. Balhi Court (opening).
3. Orizaba Avenue at Minerva Street (widening).
4. Mullen Avenue, extension to Wolfe Street.
5. Holladay Avenue and York Street, rounding northwest corner.
6. Wilder Street, extension to Arlington Street.
7. Seventeenth Street, realignment between Treat and Harrison Streets.
8. Twentieth and Noe Streets, widening southeast corner.
9. Worcester Avenue, widening Ralston Street southeasterly.
10. Anglo Alley, opening from Pacheco Street southerly.
11. Hanover Street, widening at Pope and Prague Streets.
12. Rae Avenue, Block 18, West End No. 2.
13. Rae Avenue, extension between Whipple and Farragut Avenues.
14. Geneva Terraces, Sub. No. 2.
15. Paradise Avenue, opening between Burnside and Elk Streets.
16. Bay Street, opening Lyon to Baker Streets.
17. McKinnon and Newcomb Avenues, from Selby Street to Barneveld Avenue, Upton Street, from Jerrold to McKinnon Avenue, Toland Street, from Jerrold to Oakdale Avenne, Jerrold Avenue and Selby Street, portions.
18. McLaren Park Terrace.
19. Rousseau Street, Cayuga Avenue to Alemany.
20. Capitol Avenue, widening at Lakeview.
21. San Jose Avenue, widening Ocean Avenue to Mount Vernon Avenue.

Of the above-mentioned filed maps, 19 were made in this office; the other two, which are subdivision maps, were checked as to location of streets, ties to adjacent tracts, monuments, and legal requirements.

Working maps were made and descriptions prepared of the various boulevard projects under construction, in addition to the checking of all actions to quiet title in which the City was made a party to see that there were no encroachments on City property.

Reports were also prepared of assessment districts for the extension of Minna Street from Tenth Street to Eleventh Street, and of Oakwood Street from Eighteenth Street to Nineteenth Street.

These reports have been finally adopted, and the moneys have been paid by the various property owners for these improvements.

Fees Received for Surveys and Inspection:

Month	Surveys	Inspection
1928:		
July	$ 3,590.80	$ 4,569.10
August	1,633.50	2,525.10
September	4,104.15	6,089.90
October	1,776.35	2,754.15
November	1,657.85	644.85
December	2,590.81	3,383.95
1929:		
January	9,534.31	4,627.10
February	2,955.10	1,677.50
March	2,114.50	1,790.20
April	4,498.50	4,167.45
May	1,352.50	2,996.20
June	1,902.70	1,879.60
Total	$37,711.07	$37,105.10

STREET RAILWAYS

Report on Unification of Street Railway Systems

As the result of repeated recommendations as contained in annual reports of this department for a number of years past the Board of Supervisors by Ordinance No. 8125, approved July 27, 1928, directed that the City Engineer make a complete report upon the immediate and future street railway transportation requirements of San Francisco, indicating to what extent and in what manner the existing trackage and facilities could best be utilized. The ordinance also recommended the preparation of a valuation of both the California Street Railroad and the Market Street Railway, together with a complete financial report showing the results which might be expected under municipal operation.

As shortly as possible after the passage of this ordinance, steps were taken to prepare the valuation and make the necessary traffic studies. No space being available in the City Hall for the staff of approximately fifty employees, the necessary office space was secured in the Exposition Auditorium.

California Street Cable Railroad:

As the franchises of the California Street Cable Railroad Company expired in February, 1929, special attention was directed to that company's property to the end that in December, 1928, a complete valuation and report was submitted to the Board of Supervisors. This showed the valuation of the property as of June 30, 1929, to be as follows:

	Reproduction Cost New	Reproduction Cost Less Depreciation
Land Operative	$ 115,250	$ 115,250
Track and Roadway	1,340,813	508,649
Equipment	311,334	219,517
All other Operative Property	485,061	253,988
Total	$2,252,458	$1,097,404

Some of this property was not required for the operation of the enterprise by the municipality making the values for the property required:

Reproduction Cost New	$1,762,649
Reproduction Cost Less Depreciation	903,704

Four different plans of operation were considered and the results displayed. These showed that it would be impossible for the City to take over and operate the present system under Municipal Railway employment conditions without suffering a heavy loss.

That the City might operate the property to advantage, it was planned to rebuild the tracks west of Van Ness Avenue on California Street for electric operation connecting them with the present Municipal tracks of California Street in the Richmond District, this permitting the direct operation of the "C" Line cars over California Street to Van Ness Avenue and thence downtown along O'Farrell Street. The plan proposed also called for the abandonment of cable tracks on O'Farrell Street and the operation of electric service from Grant Avenue west on O'Farrell Street, with connections to the Geary Street tracks, thus permitting loop operation of some of the Geary Street service in the downtown district. It was estimated that the capital investment in new tracks and the rearrangement of the old would amount to approximately $500,000.

Estimates in the report show that $604,463 is the maximum price which the City can pay for the parts of the system desired if interest, depreciation and bond redemption charges on the purchase price and cost of new construction are to be met out of earnings. This figure contemplates taking advantage of all savings possible through electric operation and through adjustment of cable road headways. The recommendations contained in the report were as follows:

> That the City acquire from the California Street Cable Railroad Company, for continued operation by cable, its tracks on California Street east of Van Ness Avenue and its tracks on Hyde, Pine and Jones Streets between Beach Street and Market Street, together with the power plant, car barn and other necessary operating facilities; and that the use of the cable tracks on California Street west of Van Ness Avenue be abandoned; and that standard gage double tracks be constructed in their place for electric operation; and that there be constructed on Grant Avenue and O'Farrell Street double electric tracks forming a loop with the present track on Geary Street and Van Ness Avenue; and that a double track connection be installed between the present tracks on Stockton Street and the proposed tracks on O'Farrell Street.

Several meetings of the members of the joint Finance and Public Utilities Committees, the City Attorney, City Engineer, and the officials of the California Street Cable Railroad were held, with a view to reaching a price for the property which would be agreeable to both the City and the Railroad. The price which the City could afford to pay, as indicated above, was not agreeable to the Company; therefore, no agreement was reached. The purchase of the California Street road will receive further consideration in connection with the property of the Market Street Railway Company.

Since the expiration of the franchise in February, the Cable Railroad has continued to operate under sufferance.

Market Street Railway:

On June 5th there was transmitted to the Board of Supervisors the "Valuation of the Market Street Railway Company's Property, and a report on the Street Railway Transportation Requirements of San Francisco, with Special Consideration to the Unification of the Existing Facilities." The valuation shows the grand total for the entire system of the Market Street Railway to be:

Reproduction Cost New	$46,625,506
Reproduction Cost Less Depreciation	29,369,331

After making deductions for property not desired and adjustments for reasons set forth in the report, these figures become:

Reproduction Cost New	$43,993,057
Reproduction Cost Less Depreciation	27,997,344

The present value of the holdings in the stock market 1929 ranges between $13,000,000 low to $16,000,000 high.

Franchises for 105 miles of the Company's 259 miles of single track in San Francisco County expire during the year 1929. The Company also operates 8 miles of track for which it holds no franchise, or which are covered by revocable permits. The Reproduction Cost Less Depreciation for these 113 miles of track is $5,795,806.

The Report on the Unification of Existing Facilities is a volume of 400 pages, covering in detail not only the Market Street System but also the Municipal Railway. Data contained in the California Street Cable Railroad Report and pertinent to the work of complete unification was used in making the findings.

The work included a traffic survey, which provided data used in making a rerouting study. The rerouting proposed combines all three systems into one, in such manner as to cut off needless service, provide direct transportation where required, and most effectively use the tracks. Consideration was given to the relief of traffic congestion on Market Street, and the elimination of as much transferring as possible. The rerouting suggested would allow the abandonment of 25 mi. of track, but requires the construction of 9 mi. of new track, with a net reduction of 16 mi.

Without impairing present service, and in many instances improving it, the proposed rerouting shows that it is possible to cut off approximately 10% of the car miles now operated by the three systems, through their unification. The financial results under Municipal conditions are, however, not so pleasing, as it is definitely shown that it is impossible for any street railway giving a service such as enjoyed in San Francisco to continue to operate on a five cent fare. After effecting all possible economies under Municipal operation, there would be an operating deficit of $869,667. To this must be added fixed charges which with a capital investment of $20,336,000, bring the total possible deficit to $2,346,867.

If this were made up through taxes, it would necessitate an additional assessment of 27.6 cents on each $100 of assessed value.

Some of the recommendations contained in the report are as follows:

Recommendations to Purchase

I. That a Public Utilities Commission be established for the purpose of administering the utilities of San Francisco, as is now being done in New York and Detroit.

II. That the City of San Francisco acquire by purchase, the properties of the California Street Cable Railroad and the Market Street Railway Company, at the most advantageous figures possible to be arrived at through the negotiations authorized by Ordinance No. 8125.

III. That the negotiations with the California Street Cable Railroad be on the basis of purchasing it on its earning value, namely, $604,463, as set up in my report on that Company, and that negotiations with the Market Street Railway be with a view to securing their property for $17,500,000.

IV. That the properties of the Market Street Railway and the California Street Cable Railroad, if and when secured, be combined and operated with the Municipal Railway.

V. That the fare be retained at five cents with a universal transfer privilege.

VI. That deficits resulting from the unified operation and retention of the five cent fare be met by additions to the tax rate.

Operating Recommendations

The following additional recommendations are made contingent on the acquisition and unification of the three roads with the thought of securing the most economical, efficient and satisfactory operation of the combined system:

I. That the rerouting plan set up in this report, with such modifications as developments may show to be necessary, be placed in effect.

II. That in order to speed up the transportation in the downtown district during the rush hours, all parking of vehicles be prohibited between 7 A. M. and 10 A. M. and between 3 P. M. and 6 P. M. on the streets north of Howard Street, south of Bush Street and east of Ninth Street and Larkin Street with extensions on Mission Street to Twelfth Street, Market Street to Valencia Street, McAllister Street, O'Farrell Street, Geary Street and Sutter Street to Van Ness Avenue.

III. That all licenses to operate jitney buses be withdrawn and their operation be prohibited.

IV. That the practice of exchange of transfers between buses and street cars be discontinued.

V. That the railroad system be relieved of all costs of paving except those incidental to making track repairs and any additional cost of street paving occasioned by the presence of track.

VI. That the "skip-stop" method of operation be placed in effect where street spacing permits.

VII. That the United States Post Office Department be required to pay the transportation of its employees on duty, now carried free.

No recommendations were made for acquisition of the lines as the franchises expire, as it was found that such piecemeal acquisition could not provide satisfactory service, and would lead to many complications which could be avoided by the outright purchase of the entire property.

In making these recommendations, it was taken into consideration that the Charter establishes the policy of the acquisition of public utilities for operation by the City, and further, that street railway transportation is a necessity, and that where such service is being given without adequate return, it must necessarily follow that it will become poorer and poorer.

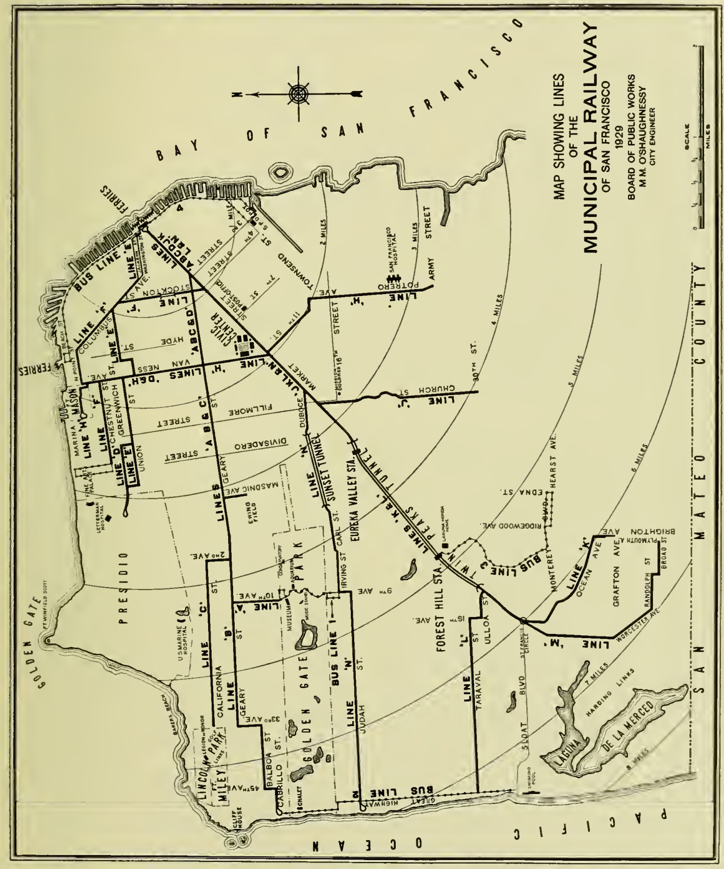
To increase the fares puts all the burden on the street railway user, which, for reasons set forth in the report, is not entirely logical. Increases of fare in other localities have not been entirely successful and if carried beyond a certain point result in decreasing rather than increasing the revenue. Therefore, the subsidizing of the street railway under municipal ownership seems to be the most logical and satisfactory means of insuring the future of this essential service.

In the hands of a proper commission, free from political control, such a municipal street railway system could be economically and satisfactorily operated to the benefit of all classes of citizens.

The valuation work was under immediate charge of Raymond C. Ashworth, who was employed in a similar capacity in this office in the Market Street valuation of 1921, while the traffic and financial studies were handled by Bruce W. Campbell, consulting railway traffic engineer, formerly connected with the State Railroad Commission. The entire work was under the direction of Nelson A. Eckart, Chief Assistant City Engineer, and Paul J. Ost, Railway and Electrical Engineer.

Revocable Permit Initiative:

As Proposition No. 24 on the November, 1928, ballot there appeared an initiative petition which, if carried, would have made it possible for the street railways to surrender their franchises and secure in place thereof what was termed a revocable permit. The difficulty about these revocable permits was the fact that they could be revoked only by the purchase of the entire property of the Company. An aggressive campaign was carried on in favor of the proposition by means of newspaper and billboard advertising, and door to door solicitation. Apparently it was desired to have this amendment carried prior to the submission of the report on unification. Had this proposition been approved, the Market Street Railway would have been in a favorable position to negotiate a higher price for the property than they are when operating under franchises with relatively short lives remaining. This amendment received the heaviest vote of any of the sixty-two propositions on the ballot, indicating the interest of the public, but was decisively defeated by a vote of 72,156 for, and 100,526 against. The Company's position was indicated by the fact that it reports having spent over $30,000 in the campaign.



MAP SHOWING LINES
OF THE
MUNICIPAL RAILWAY
OF SAN FRANCISCO
1929
BOARD OF PUBLIC WORKS
M. M. O'SHAUGHNESSY
CITY ENGINEER

Sunset Line:

The year just passed has seen the opening of another important Municipal Line, namely, the "Sunset" or "N" Line, which operates from the Ferry via Market Street to Duboce Avenue, thence through the new Sunset or Duboce Tunnel to a point near Carl and Cole Streets, thence over the Market Street Railway Company's tracks to Stanyan and Carl Streets, from which point new tracks were constructed along Carl Street to Arguello Boulevard, thence to Irving Street to Ninth Avenue, Ninth Avenue to Judah Street, and on Judah Street to a loop at the Ocean Beach. This line was opened on October 21, 1928, and almost since the commencement of operation, the gross revenue has been second only to that of the original "B" Line operating on Geary Street. The use of the tunnel has materially decreased the running time from the Sunset District to the downtown section.

The construction employed is the same as in other sections of the system, the line being laid with 106-lb. grooved girder rail, except in the tunnel, where 70-lb. A. S. C. E. rail was used. Concrete trolley poles were installed over the length of the line, those in the Sunset District being fitted with conduits and bolt holes which will permit the attachment of bracket street lights fed from underground cables.

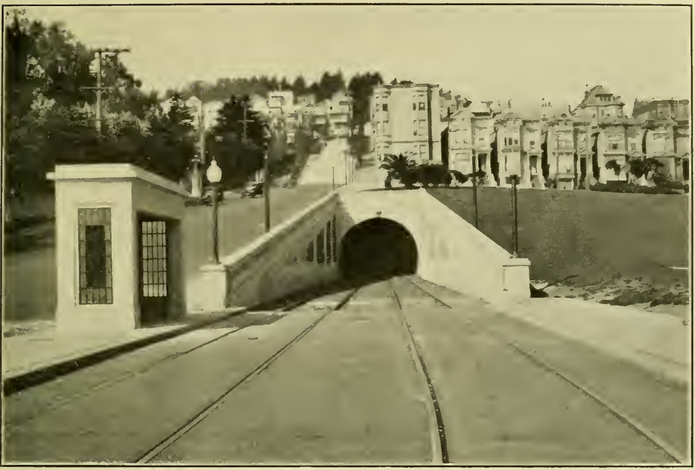
The contracts covering the work are set forth in detail under the tabulation of "CONTRACTS."

No satisfactory power supply was available for this line, which is located some little distance from any existing substation of the Pacific Gas and Electric Company, from which power could be obtained. Under agreement with the Power Company, a new 3000 kw. automatic substation has been erected on Ninth Avenue just south of Judah Street, to supply all of the energy for the entire line, and assist in furnishing energy for the Taraval Street Line. It is now planned to run a feeder from this station to the Forest Hill station of the Twin Peaks Tunnel, for the purpose of improving the power supply in the tunnel.

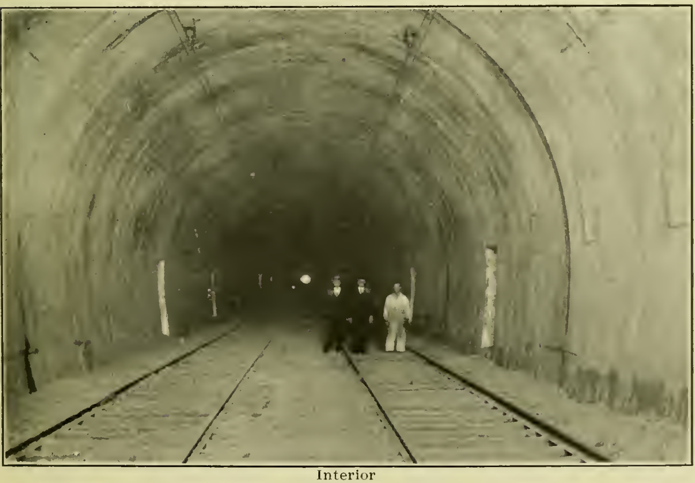
Automobile Bus Operation:

The Municipal Railway is operating five bus lines, and the Market Street Railway two bus lines. All of these charge a five cent fare and exchange free transfers with the street car lines. As is to be expected under these conditions, all seven lines are losing money. Both the Superintendent and the City Engineer have recommended the elimination of free transfers between Municipal street cars and buses, and the discontinuance of the operation of the bus line into the Marina District. The carrying out of these recommendations would result in a decrease in loss to the Municipal Railway of approximately $45,000 a year. In New York and Chicago bus fares are 10 cents.

The Marina Bus Line mentioned above was established as an experimental line whose continuance for ninety days was ordered by Ordinance No. 8075 on June 14, 1928, followed on October 18, 1928, by Ordinance 8231, ordering its permanent operation.



East Portal



Interior

SUNSET (DUBOCE) TUNNEL

During the year, requests have been made for the establishment of a number of new bus lines, all of which, with one exception, have seemed undesirable. This exception is the line to serve the Southern Heights District, which was promised a number of years ago, contingent upon the people of the District making certain street changes which would reduce the grades. These street changes have now been made, but there are no funds available for the purchase of the buses and to meet the anticipated possible deficits from the operation of the line.

An additional six-cylinder bus replacing old buses is necessary in order to maintain satisfactory service on the Westwood Park run. Prices were secured and recommendations to purchase from the Depreciation Reserve Fund were sent to the Board of Public Works on February 28th. To date, no action has been taken by the Board of Public Works. This failure to act is likely to result in the curtailment of service through the failure of the present equipment.

Shop and Garage Facilities:

The Municipal Railway now operates 234 street cars, 18 automobile buses, and a considerable number of work cars, automobiles and service trucks. The present shop facilities at Geary and Presidio Avenue were designed to take care of the original Geary Street Railway operation involving 43 street cars, and while they are reasonably well equipped for street car maintenance, are so crowded as to make efficient work difficult.

No provision was made in the original construction for the housing and maintenance of automobile buses. The situation with relation to the automotive equipment has become very acute, and an appropriation of $50,000 has been requested several times with which to provide garage facilities through the erection of a second story over part of the first floor of the Car Barn at Seventeenth and Hampshire Streets. No definite action has been taken on this request by the Board of Supervisors, and it is still necessary to park the buses in the public street at night, with no suitable facilities for servicing and repairing them. The situation during the winter months is extremely bad. This matter should receive immediate attention.

Material Storage:

Maintenance of way material for the Municipal Railway is received, stored and issued from the Municipal Pipe Yard at Sixth and Hubbell Streets. This property is leased from the Southern Pacific Company on a year to year basis. This makes permanent improvement inadvisable, consequently some of the material is not properly protected from the elements. The location is entirely off the Municipal Railway lines, making it necessary to haul all material out of the yard by truck, instead of using work cars on a track, which would materially reduce the cost of handling. It has been recommended that the block immediately west of the Seventeenth Street Car Barn be purchased for the erection of a shop and for the storage of materials. One-half of the block has already been bought, but no funds are available for the purchase of the balance of the property and carrying out of the original plan.

Depreciation Study:

On June 5, 1929, at the request of the Public Utilities Committee of the Board of Supervisors, this office submitted to them a report and estimate of the expenditures which should be made from the Municipal Railway Depreciation Reserve Fund during the ensuing six years. This was compiled after careful inspection of the tracks and other facilities, and indicated that the 3% of the original cost now being set aside annually is hardly sufficient to take care of the needs of the next few years. When the present fund and future additions were divided on the basis of the probable life of the different classes of plant, it was found that the amount allocated to replace track, trolley and automotive equipment, would fall short of meeting such replacements between 1929 and June 30, 1935, by the sum of $543,188. If all the money necessary for the replacement of track, trolley and automotive equipment is taken from the Depreciation Reserve Fund, the amount remaining in the fund at June 30, 1935, if there are no other withdrawals in the meantime, will be $350,346, which will be the only reserve accumulated during twenty-three years for the replacement of all property other than track, trolley and automotive. This accumulation will be dangerously low, if the property is to be maintained in good condition without drawing on other sources for funds necessary to make replacements.

CURRENT CONTRACT DATA, 1928-1929

Applying to City Pay Contracts and Major Contracts Involving City Funds

Description	Contractor	Awarded	Completed Date	Completed %	Contract Amount	Expended to 6/30/29	Fund
Paving, Grading, Etc.							
Alemany Blvd., Sec. B, Cont. 4, Mission St. to Ocean Ave.	Eaton and Smith	3/ 9/28	3/12/29	100	$138,902.70	$138,902.70	Boulevard Bonds
Alemany Blvd., Sec. D-1, Cont. 10, Sickles Ave. to Orizaba Ave.	Hanrahan Co.	9/12/28		a	(49,884.12)		Boulevard Bonds
Alemany Blvd., Sec. E, Cont. 5, Orizaba to Junipero Serra	Granfield, Farrar and Carlin	8/27/28	6/ 4/29	100	71,364.41	66,500.00	Boulevard Bonds
Alemany Blvd., Sec. E, Cont. 18, Orizaba to Junipero Serra (N'ly half)	Federal Construction Co.	4/29/29		31	28,956.04		Boulevard Bonds
Bayshore Blvd., Sec. A, Cont. 6, Potrero Ave. to Silver Ave.	L. J. Cohn	6/11/28		77	(224,347.98)	156,450.00	Boulevard Bonds
Bayshore Blvd., Sec. B, Cont. 3, Silver Ave. to Paul Ave.	Federal Construction Co.	3/ 2/28	2/26/29	100	162,416.58	161,500.00	Boulevard Bonds
Bayshore Blvd., Sec. C, Cont. 12, Paul Ave. to Third St.	Municipal Construction Co.	4/ 8/29		7	(74,123.38)		Boulevard Bonds
Bayshore Blvd., Sec. D, Cont. 7, Third St. to Tunnel Ave.	Granfield, Farrar and Carlin	8/27/28		88	(212,805.66)	150,000.00	Boulevard Bonds
Bayshore Blvd., Sec. E, Cont. 11, Tunnel Ave. to County Line	Federal Construction Co.	4/30/29		34	(107,115.38)	8,700.00	Boulevard Bonds
Great Highway, Cont. 8, Lincoln Way to Sloat Blvd.	Granfield, Farrar and Carlin	7/16/28	6/ 7/29	100	239,263.34	239,263.34	Boulevard Bonds
Great Highway, Cont. 15, Fulton St. to Lincoln Way	Healy-Tibbitts Construction Co.	3/18/29		53	(77,704.30)	35,100.00	Boulevard Bonds
Junipero Serra Blvd., Cont. 13, Sloat Blvd. to County Line	Eaton and Smith	3/25/29		4	(374,396.50)		Boulevard Bonds
Nineteenth Ave. Extension, Cont. 14, Sloat Blvd. to Worcester Ave.	Eaton and Smith	2/25/29		22	(257,142.60)	43,050.00	Boulevard Bonds
Silver Ave., San Bruno to Scotia St.	Eaton and Smith	9/23/25	5/22/29	100	20,707.65	9,563.58b	County Roads and Property Owners
Montgomery St., Green to Union Sts. (Grading, Walls, Paving)	Fay Improvement Co.	9/14/27	7/ 2/28	100	18,586.02	10,389.36b	County Roads and Property Owners

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(See Notes Page 59)

CURRENT CONTRACT DATA, 1928-1929

Applying to City Pay Contracts and Major Contracts Involving City Funds

Description	Contractor	Awarded	Completed Date	Completed %	Contract Amount	Expended to 6/30/29	Fund
Paving, Grading, Etc.							
Holladay Ave., Peralta Ave. to Adam St. (Grading, Walls & Paving)	Schultz Const. Co.	2/10/28	7/10/28	100	$ 32,564.98	$ 32,564.98	County Roads
Lower Terrace, Saturn to Levant Sts. (Grading, Stairs, Paving)	Western Construction Company	3/ 9/28	8/ 6/28	100	6,075.25	1,648.22b	County Roads and Public Assessment
Parker Ave., California St. to Euclid Ave. (Widening, Paving)	Fay Improvement Co.	3/26/28	12/18/28	100	4,210.73	4,210.73	County Roads
Santiago St., 22d to 24th Aves.	Fay Improvement Co.	9/14/28	2/11/29	100	14,224.00	14,224.00	County Roads
Kezar Stadium Roadway	James M. Smith	9/14/28	2/ 6/29	100	62,294.34	62,294.34	County Roads
Bernal Cut, Cont. No. 1 (Bridges, Grading & Paving)	MacDonald & Kahn, Inc.	10/ 3/28		25	(504,829.39)	121,050.00	Bernal Cut Bonds
Marina Blvd., Webster to Lyon Sts. (Sidewalks & Track Crossings)	Fay Improvement Co.	10/ 5/28	12/21/28	100	3,803.29	3,803.29	County Roads
Wisconsin St., Twenty-third to Twenty-fifth Sts.	Meyer Rosenberg	10/19/28	4/ 2/29	100	10,835.50	10,835.50	County Roads
Coso Ave., Prospect Ave. to Winfield St. (Stairs, Paving)	M. J. Lynch	10/19/28	2/26/29	100	4,856.04	4,856.04	County Roads
Laguna Honda Blvd. (7th Ave.) Lawton St. southerly to Plaza (Grading, Walls, Macadamizing)	J. P. Holland, Inc.	12/31/28		72	(103,520.56)	52,800.00	County Roads
Bernal Hts. Blvd., Cont. No. 1, Powhattan to Esmeralda (Grading, Macadamizing)	E. J. Treacy	2/27/29		90	(5,140.40)	4,350.00	General Fund
Roosevelt Way, Cont. No. 3, 14th St. to Buena Vista Terrace	C. L. Harney	6/17/29			(9,685.80)		County Roads

(See Notes Page 59)

CURRENT CONTRACT DATA, 1928-1929

Applying to City Pay Contracts and Major Contracts Involving City Funds

Description	Contractor	Awarded	Completed		Contract Amount	Expended to 6/30/29	Fund
			Date	%			
Miscellaneous							
Sunset Tunnel (Duboce Ave. Route)	Youdall Construction Co.	5/10/26	12/ 7/27	100	($1,340,068.88)	$1,338,318.88	Assessment Fund
Municipal Airport, (Mills Field):							
Contract No. 8—Grading (Depressions and Runways)	Jas. M. Smith	7/ 1/27	7/18/28	100	40,839.37	40,839.37	General Fund
Contract No. 9—Hangar No. 2	Stephenson Construction Company	9/12/27	3/13/28	100	101,033.44	101,033.44	General Fund
Contract No. 11—Runway Construction and Drainage	Meyer Rosenberg	10/15/28	2/13/29	100	46,450.00	42,300.00	General Fund
Contract No. 12—Grading (Filling Depression)	Meyer Rosenberg	4/22/29	6/19/29	100	2,275.24	2,000.00	General Fund
Pedestrian Tunnel Extensions, Skyline Blvd. at Fleishhacker Pool	L. J. Cohn	1/13/28	10/11/28	100	14,092.58	14,092.58	County Roads
Esplanade, Sec. E, Ocean Beach, Contract No. 1	Healy-Tibbitts Construction Co.	3/ 2/28		99	(346,000.00)	344,000.00	Boulevard Bonds
Third St. and Channel Bridge:							
Tie Rod Anchorage	L. J. Cohn	1/27/28	10/11/28	100	12,521.12	12,521.12	County Roads
Fender Piling Repairs	Renner Foundation Co.	6/18/28	7/10/28	100	1,400.00	1,400.00	General Fund
Test Borings	Healy-Tibbitts Construction Co.	1/25/29	5/ 1/29	100	(2,266.00)	2,000.00	County Roads
Street Signs, Contract No. 8	D. C. McCabe	8/20/28	2/13/29	100	3,712.00	3,712.00	General Fund
Auxiliary Water System, Ext. No. 7, Franklin and Grove Streets	E. J. Treacy	9/21/28	4/30/29	100	18,127.91	16,450.00	War Memorial Trust Fund
Sewage Pumping Station, Fitzgerald Ave. and Griffith St.	Ajax Construction Co.	11/ 5/28	2/ 6/29	100	3,691.00	3,691.00	General Fund
Traffic Turning Buttons, Contract No. 1	E. J. Treacy	11/16/28		85	8,160.50	5,625.00	General Fund
Laidley St. Slide, Test Borings	A. Paulsen	1/18/29	3/ 5/29	100	1,817.62	1,817.62	County Roads
Beale and Harrison St. Bridge, Painting	D. E. Burgess	3/ 8/29	5/ 8/29	100	1,361.01	1,361.01	General Fund

(See Notes Page 59)

CURRENT CONTRACT DATA, 1928-1929

Applying to City Pay Contracts and Major Contracts Involving City Funds

Description	Contractor	Awarded	Completed Date	Completed %	Contract Amount	Expended to 6/30/29	Fund
Sewers							
Thirtieth Ave. Sewer, Sunset District—Contract No. 5	Federal Construction Co.	8/ 7/27	7/25/28	100	$ 28,989.00	$ 28,989.00	General Fund
Fillmore St. Main Sewer, Contract No. 1, Sec. A—10th St. Harrison to Division Sts.	Clarence B. Eaton	2/20/28	9/29/28	100	45,823.29	45,823.29	General Fund
Bayshore Blvd. Storm Drain, Contract No. 2, Crossing Alemany Blvd.	L. J. Cohn	3/ 2/28	11/20/28	100	62,119.12	62,119.12	Boulevard Bonds
Laguna Honda Blvd. Sewer, Noriega St. southerly	C. C. W. and H. H. Haun	4/25/28	1/22/29	100	37,709.95	37,709.95	General Fund County Roads
Wawona St. Sewer, 25th to 34th Avenues	Frank J. McHugh	5/18/28	9/26/28	100	24,331.51	24,331.51	General Fund
Guttenberg St. Sewer Extension	Hugh McGill	6/11/28	9/29/28	100	7,245.76	7,245.76	General Fund
Franklin St. Sewer, Fulton to Grove Streets	E. J. Treacy	9/ 7/28	11/28/28	100	4,008.40	4,008.40	War Memorial Trust
Quintara St. Sewer, 40th to 46th Avenues	Martin Murphy	11/ 5/28	4/ 2/29	100	21,470.49	21,470.49	General Fund
Municipal Railways							
Sunset Line, Construction Contract No. 155	Eaton and Smith	9/30/27	11/15/28	100	265,469.41	265,469.41	Municipal Railway Depreciation
Electric Cables, Lead Covered, Contract No. 156A	American Brass Co.	6/ 3/27	10/31/28	100	10,542.84	10,542.84	Municipal Railway Depreciation
Electric Cables, Weatherproof and Bare, Contract No. 156C	Pacific States Electric Company	6/ 3/27	11/24/28	100	8,464.45	8,464.45	Municipal Railway Depreciation
Electric Conductors and Appurtenances, Installation, Con. No. 158	Robert W. Jamison	8/ 6/27	11/27/28	100	18,095.24	18,095.24	Municipal Railway Depreciation
Rail Bonds, Contract No. 160	Robert W. Jamison	9/30/27	11/20/28	100	10,369.51	10,369.51	Municipal Railway Depreciation

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Contract amounts in parenthesis (..........) are based on estimated quantities.
a. Work delayed by right of way condemnation suits.
b. Balance paid by property owners.

HETCH HETCHY WATER SUPPLY

Progress and Development

During the fiscal year 1928-29, driving of the 16-mi. tunnel of the Foothill Division was completed and the placing of concrete lining had proceeded with such speed as to forecast its completion in September, 1929. Excavation at Moccasin Dam was completed and a portion of the concrete core wall poured. Nearly five miles of tunnel in the Coast Range Division have been driven and completion of this tunnel, together with the San Joaquin Pipe Line, is predicted for 1932, if construction operations are not embarrassed and funds are available when required.

Moccasin Power Plant has continued power production, although extraordinary weather conditions reduced the output during the period from December 17, 1928, to March 17, 1929. The net earnings during the year amounted to $1,600,000, making a total of $7,300,000 for the period since beginning power production.

Operation of the Bay Crossing Division under lease by Spring Valley Water Company continues as in previous years. Owing to the abnormally low rainfall, this aqueduct is being called upon to deliver a much smaller amount of water than in the preceding year. Storage in the local reservoirs at the present time is barely sufficient for one year's consumption.

It is much to be regretted that the condition of the bond market has been such that the $41,000,000 Spring Valley Bonds are temporarily unsalable, so the City has not yet been able to take over operation of the local water system.

Organization and Headquarters Work

The Hetch Hetchy Water Supply work continues under the direction of M. M. O'Shaughnessy, City Engineer, assisted by Nelson A. Eckart, Chief Assistant Engineer, as in previous years.

City Headquarters Office:

The City office staff lays out, designs and prepares plans and specifications for all projected work; makes additional plans when necessary for work under construction and for units completed and in use; prepares maps and descriptions of lands and rights of way to be purchased; selects and purchases equipment for day labor work; directs the operation of the Hetch Hetchy electric power system; and checks and passes for payment all bills and payrolls. The staff personnel consists of L. W. Stocker, Civil Engineer; P. J. Ost, Electrical Engineer; R. L. Allin, Hydraulic Engineer; H. W. Kephart, Purchasing Agent; J. J. Phillips, Right of Way Agent; and a number of assistant engineers, draftsmen and clerical employees.

Some of the more important items of work handled in the designing office during the past year are mentioned below:

The design of the main dam for the Moccasin Reregulating Reservoir and the 10 foot diameter by-pass conduit which is to carry the natural flow of Moccasin Creek under the reservoir was completed and drawings for these structures were made during the year. Studies and preliminary designs were made for the spillway and spillway gates for this reservoir. Methods of constructing the dam and spillway were studied and certain features of the construction plant were designed and drawn.

Detail drawings were completed for the surge shaft in connection with the main aqueduct tunnel east of Red Mountain Bar and for the overflow shaft located about 1500 feet east of Oakdale Portal in the Foothill Division. Concrete lining for tunnels requiring special treatment in lining, and for shafts and adits in this division was designed and drawings made.

Studies were made for a projected power plant to be located on the Foothill Division aqueduct line at Red Mountain Bar to utilize for power generation the water discharged from the Moccasin plant in excess of that required for transmission to San Francisco. While this plant may not be constructed for some time, the aqueduct at this point is to be designed to serve the power plant and to permit convenient connection of the short branch pipe line to extend to the power house. Design is in progress for the uncompleted portion of the Red Mountain Bar siphon.

Designs and drawings were completed for concrete lining of shafts and adits and for tunnel sections in the Foothill Division of the Tunnel aqueduct requiring special treatment, and for underground stations, crosscuts, tunnels, and pump sumps at the five shafts along the Coast Range Division. In connection with this work and for further use in designing the lining for tunnels, extensive tests of underground pressure were made and these are still in progress.

The engineering and survey work done in connection with the acquisition of the properties of the Spring Valley Water Company is described later in this report.

Land descriptions were prepared for deeds and other documents for the acquisition of practically all remaining lands and rights of way necessary for camps, tunnels and transmission lines in the Coast Range Division. Descriptions were also prepared for land granted by the City to the United States under provisions of the Raker Act, and for many permits and leases granted during the year.

Progress for the fiscal year on the program being carried out for the maintenance of real estate records as described in the Annual Report for 1926-27, pages 50 and 51, includes the completion of the final maps and profile drawings for the Coast Range Division and the preparation of deed lists for the Mountain Division and the Hetch Hetchy Railroad. This work has been intermittent, being suspended when the men engaged on it were required for more urgent work.

Contracts:

Plans and specifications were completed and a contract was let for Contract No. 119, for furnishing and delivering outlet gates and appurtenances for the Moccasin Reregulating Reservoir. Work under this contract has been completed and final payment made.

Specifications were prepared for Contract 120, for furnishing and delivering a portable gravel plant to be used in the Coast Range Division. Bids will be received on July 10th.

Contract No. 113-C for driving and lining tunnels in the Rock River and Oakdale sections of the Foothill Division aqueduct continued in force throughout the year.

Contract No. 113-E for driving tunnel in the Brown Section of the Foothill Division aqueduct was completed but final payment has not yet been made.

Appended to this report is a table of detail data on current contracts for the year 1928-1929.

The purchasing department handled purchases of miscellaneous materials, supplies, etc., aggregating $1,927,412, and payments for lands, etc., amounting to $43,754 during the fiscal year.

Field Headquarters:

At Hetch Hetchy Junction Headquarters, L. T. McAfee, Construction Engineer, is in charge, and is assisted by the same staff as in the previous year. His office handles the work of the Foothill Division and the preliminary work in the San Joaquin Division east of the San Joaquin River. All buildings here are on property under direct control of the City, either bought in fee or leased.

Accounting of the entire Hetch Hetchy activities of the Board of Public Works is under the direct charge of Willis O'Brien, Chief Accountant, with offices at Hetch Hetchy Junction and Livermore.

At Livermore headquarters, C. R. Rankin, Construction Engineer, is in charge. His staff has been recruited largely of men from the completed divisions of the work and of specialists transferred from the Foothill Division. Mr. Rankin handles the Coast Range Division construction, preliminary work in San Joaquin Division west of the river and keeps in touch with conditions on the completed Bay Crossing Division.

At Moccasin Headquarters, Thornton Easler, Assistant Electrical Engineer, is in charge of maintenance and operation of the power system and the completed aqueduct used in the generation of power.

Field Employees:

The number of employees in the field increased during the fiscal year from 800 at the beginning to 1380 at the end of the year, due to additions to the forces in the Coast Range Division. This increase was the result of starting tunnel driving in the fourteen headings in this division.

The following table shows the number of men, including the City's field engineering staffs, employed on the various jobs on June 30, 1928, and on June 30, 1929:

	June 30, 1928		June 30, 1929	
	Construction	Operation	Construction	Operation
Lake Eleanor Reservoir	....	1	....	1
O'Shaughnessy Dam	....	2	....	2
Lower Cherry Power System	....	7	....	7
Early Intake Diversion Works	....	2	....	....
Priest Reservoir	....	....	....	....
Moccasin Headworks	....	1	....	1
Moccasin Penstocks	....	1	....	2
Moccasin Power House	....	24	....	24
Moccasin Re-regulating Reservoir	*	....	*	....
Moccasin Transmission Line	....	5	....	6
Hetch Hetchy Railroad (operation in connection with construction work)	12	....	....	....
Foothill Division Aqueduct:				
City Forces	289	....	354	....
Contractor's Forces	188	....	92	....
Coast Range Division Aqueduct	228	....	852	....
General and Miscellaneous	34	6	34	5
TOTALS	751	49	1332	48
Total, construction and operation	800		1380	

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* Included in Foothill Division Aqueduct.

Medical Service:

The City continues to maintain at Groveland a fully equipped hospital with a capacity of seventy-five patients. A physician, Dr. J. P. Degnan, and three trained nurses constitute the staff. An assistant physician, quartered at Hetch Hetchy Junction until April, 1929, had supervision of a first aid station and made daily trips to the camps of the Foothill Division, carrying on the routine work of examinations, dressing, etc. This service was discontinued when the number of workmen in this division became too small to require it.

The record of cases treated at the Groveland Hospital follows:

Non-hospital cases		750
Hospital cases, City employees	169	
Hospital cases, Contractors' employees (A. Guthrie and T. E. Connolly)	89	
Hospital cases, outside pay patients	70	
Total hospital cases		328
Total cases treated		1078
Capital operations		200

Average time in hospital for hospital cases 14 days.

Relations With the United States Department of the Interior:

Due to the good will of President Hoover and Secretary Wilbur, an attitude of friendly interest is being manifested in the administration of the City's activities in Yosemite National Park and the general tone of relations between the City and the Department has changed during the past year from one of controversy to one of cooperation. (See report for 1927-28, pages 72-77). The City has demonstrated its willingness to comply with a reasonable interpretation of the obligations imposed upon it in the Raker Act by the prompt action taken on certain of the requests made by the Secretary of the Interior by letters of July 7, 1927, and May 18, 1928. The government officials, on the other hand, apparently have seen the justice of the City's contentions on certain road construction requirements and the importance of enforcing proper regulations looking to the protection of our reservoirs and watersheds from pollution by tourists and sportsmen.

Action taken by the City during the year in compliance with the recent requests of the Secretaries of the Interior and of Agriculture and in fulfillment of Raker Act provisions included the following:

Land Conveyances:

A deed to the City's lands at the junction of Cherry and Eleanor Creeks, commonly called the Junction Camp lands, a 640 acre parcel covering all of Section 16, township 1 North, Range 19 East, has been prepared, recorded and transmitted to the Secretary of the Interior through the Secretary of Agriculture. An abstract of title covering these lands was procured and transmitted with the deed as evidence of the City's title to these lands and that "a good and sufficient title free from all liens and encumbrances of any nature" was being conveyed to the government. This deed and abstract are now in the hands of the Department of the Interior awaiting formal acceptance by the department.

The "Junction Lands" are the only property of the City in the Stanislaus National Forest adjacent to the Yosemite National Park which the City is conveying to the Government at this time. The Mather or Hog Ranch lands, a 328.78 acre tract located at Mather Station on the Hetch Hetchy Railroad, also in the Stanislaus National Forest, are not being conveyed to the Government at this time as they are being used for maintenance crews and are necessary for use in connection with future major construction.

A deed was prepared and an abstract of title procured and both transmitted to the Secretary of the Interior, covering the following lands in the Yosemite National Park:

I. Canyon Ranch Lands, containing 165.76 acres and being all of the E½ of NW¼, the SW¼ of the NW¼, and the NW¼ of the SW¼ of Section 32, Township 1 North, Range 20 East.

II. All of the lands of the City and County of San Francisco in the Hetch Hetchy Valley lying above the ultimate flow line of the Hetch

Hetchy reservoir, containing 149.1 acres and comprising portions of the SE¼ of Section 9, the S½ of the NE¼, the S½ of the NW¼, the N½ of the SW¼, and the NW¼ of the SE¼ of Section 10, the SW¼ of the NW¼, and E½ of the S½ of Section 11, the NW¼ of the NE¼, and the NE¼ of the NW¼ of Section 16, Township 1 North, Range 20 East.

III. All of the lands of the City and County of San Francisco at Lake Eleanor lying above the ultimate flow line of the future reservoir, containing 263.5 acres and being portions of the S½ of the NE¼, the N½ of the SE¼, and the SE¼ of the SE¼ of Sec. 34, the SW¼ of the NW¼, the W½ of the SW¼, and the SE¼ of the SE¼ of Section 35, and all of Section 36, Township 2 North, Range 19 East.

IV. Tiltill Valley Lands, containing 160 acres and being all of the SW¼ of the NE¼, the S½ of the NW¼ of Section 5, the SE¼ of the NE¼ of Section 6, Township 1 North, Range 21 East.

This deed was formally accepted by the Secretary of the Interior on behalf of the United States of America on May 11, 1929.

When the Junction Camp lands are accepted, the City will have conveyed to the United States 1698 acres of land (including the Dudley property of 320 acres deeded to the government in 1918).

Road and Trail Construction:

A survey for the location of the trail to be constructed along the north side of Hetch Hetchy reservoir and to Tiltill Valley and Lake Vernon was completed during the year and a map was prepared showing the location and specifications for the construction of these trails. The map was approved by Mayor Rolph under authority of Resolution of the Board of Supervisors No. 29761. This map and specifications and a profile of the trails, were sent on February 19, 1929, to the Secretary of the Interior for his approval. The construction of these trails will be undertaken as soon as the plans and specifications are approved.

In 1926 the City contributed $6,000 for a survey of the Mather-Harden Lake-Tioga Road by the United States Bureau of Public Roads. The funds were insufficient and upon request of the Director of National Parks, the Board of Supervisors by Resolution No. 30124, approved December 19, 1928, appropriated $500 additional for this purpose. This latter sum was delivered to the Director on February 19, 1929.

At the request of the City Engineer, the Bureau of Public Roads made an estimate of cost of a survey for a road running easterly from a point near Mather Station to connect with the present survey between Canyon Ranch and Harden Lake, as provided in the Raker Bill. This survey will cover an alternative location for the westerly portion of the Mather-Harden Lake-Tioga road over land outside the watershed tributary to the City's water supply.

The estimated cost of surveying this 6 mile road is $4,200 and, as previously, this money will be provided by the City.

Watershed Sanitation:

As a precaution against pollution of the City's water supply, signs have been prepared and will be posted conspicuously at the places on the watershed likely to be visited by tourists or sportsmen. The lettering on the signs, which is reproduced below, was proposed by the City Engineer and approved by the Director of the National Park Service.

NOTICE!
PUBLIC WATER SUPPLY
DO NOT POLLUTE

UNDER ACT OF CONGRESS—H. R. 7207 Approved December 19, 1913.—It is forbidden to place in the waters of HETCH HETCHY RESERVOIR or LAKE ELEANOR or in ANY STREAM leading thereto, or within 300 FEET thereof, any HUMAN EXCREMENT—GARBAGE—OR OTHER REFUSE.

No person shall BATHE, WASH CLOTHES OR COOKING UTENSILS, or WATER STOCK in, or in any way POLLUTE, these RESERVOIRS, or the STREAMS leading thereto WITHIN ONE MILE of the RESERVOIRS, or the TUOLUMNE RIVER between EARLY INTAKE and HETCH HETCHY DAMSITE, or the waters entering the river within one mile thereof.

Any person violating this Act will be prosecuted to the full extent of the law.

CITY AND COUNTY OF SAN FRANCISCO,
By M. M. O'Shaughnessy,
City Engineer.

U. S. DEPT. OF THE INTERIOR,
Horace M. Albright,
Director, National Park Service
By C. G. Thomson,
Supt., Yosemite Nat'l. Park.

May 29, 1929.

Mather Recreation Camp:

Since July, 1924, the Playground Commission has been operating a summer recreation camp at Mather Station on property acquired by the City Engineer's office. The resort has increased in popularity and in the season of 1928 accommodated 535 guests registered from the City office of the Commission in addition to several hundred transient guests.

A program of improvements has been carried on throughout the past two years. The work cost $15,800 and was done by Hetch Hetchy Water Supply forces under the general direction of the Playground Commission. The work done included the construction of 25 cabins, 3 washrooms, a storeroom, a swimming pool for small children, a complete sanitary sewer system with septic tank and pumping plant, erection of rustic fences, benches and tables, rehabilitation of the kitchen and dining room and installation of a modern electric bake shop.

Automobile Tourist Camp:

The automobile tourist camp constructed in 1927 near Mather Station on the Hetch Hetchy Railroad continues in operation. It provides a camping place with all necessary facilities, on land not draining into the streams or reservoirs from which San Francisco will take its water supply. This camp, although off the watershed, is still within easy reach of all points of interest, being only 9 miles from the Hetch Hetchy Reservoir. Its operation and maintenance are under the supervision of the City Engineer. No charge is made for the use of the camp ground and facilities.

Hetch Hetchy Railroad:

There has been no steam service on the railroad during the fiscal year. Gasoline motor cars are used occasionally, especially during the snow season, for maintenance of power and telephone lines, as well as for other purposes.

The equipment of the railroad remains as in the two last previous years. The rolling stock is listed in the Annual Report for the fiscal year 1926-1927 on page 57.

Very little work on track and roadbed was done besides maintenance of culverts, ditches and road crossings.

A spur track at Hetch Hetchy Junction was constructed by the Sierra Railway to deliver rock, sand and cement to the stock piles and warehouse at the head of the shaft. The City's forces built the trestle and bunkers and installed the material handling equipment at the end of the spur.

Storage Reservoirs:

At the storage reservoirs, Hetch Hetchy and Lake Eleanor, the same operating force is maintained as in previous years. A small crew removed logs from Lake Eleanor as in the previous year and did other small maintenance work on roads and buildings.

The road to Lake Eleanor remained closed to automobile travel during the year, no automobiles, except on official business, being admitted. A ranger acting under instructions from the Yosemite National Park authorities has enforced regulations as to the use of this road. It is used by hikers and horsemen visiting the lakes and streams in the vicinity of Jack Main Canyon and in the northerly part of Yosemite National Park.

Lower Cherry Aqueduct:

The Lower Cherry aqueduct above the Early Intake Power House, constructed in 1917, is partly flume, partly tunnel and partly concrete lined ditch. The flume of wood has been in continuous use since 1917, and was badly in need of repairs. In order to do this work, the water flowing from Lake Eleanor was cut off from August 7th to October 6th.

During this period of the year it was possible to undertake the work without losing water which could otherwise be used in the generation of power. All of the water stored in Lake Eleanor was used after commencing draft on October 6th.

The tunnels were found to be in good condition, but advantage was taken of the opportunity to patch up such seams as might cause leaks, and to make minor repairs to the concrete canal and remove some rocks which had fallen in. The wearing away of the flume battens had caused considerable leakage, and the scouring of the sand had worn the bottom boards quite badly in places. The old wooden battens were removed, and where the bottom of the flume was too badly worn to repair, a new bottom was laid, after which all joints were covered with light sheet metal strips which have so far proven very satisfactory in preventing leakage.

Main Aqueduct:

The main mountain aqueduct from Early Intake to Priest Reservoir has been in continuous use since June, 1925, and the low water period was utilized to permit of making an inspection of the entire length of the aqueduct. On December 20th, the portion from Early Intake to Adit 8-9 was inspected, and on December 30th the section from Adit 8-9 to Priest Reservoir was gone through. The tunnel was found to be in excellent condition.

This inspection was particularly useful at this time in connection with flow studies which are being carried on in the City Office. Several flow tests have been made on the Mountain Division aqueduct in the past two years. These tests, with the operating statistics of the Moccasin Power Plant, have been used as the basis of the flow studies, which are still in progress.

The aqueduct crossing South Fork of Tuolumne River is a steel pipe 9½ ft. diameter. On account of the precipitous nature of the canyon walls, the top of the pipe is covered by timbers as a fender protection against falling rock. One or two small slides have indicated that this timber protection might not be sufficient to prevent minor injury to the pipe. During the year a rock filled timber crib was constructed on the east side of the South Fork as an additional protection.

Power System Operation

The Moccasin and Early Intake Power Houses have continued to operate satisfactorily during the past year. The power output for the past three years is shown on the following table:

Power Generation and Disposition

	1926-1927 kw.-hrs.	1927-1928 kw.-hrs.	1928-1929 kw.-hrs.
Generated by Moccasin P. H.	513,295,500	526,468,000	448,667,000
Generated by Early Intake P. H.	12,158,900	18,884,300	6,126,700
Received from P. G. & E. Co.	17,000	1,000	2,000
Total Power	525,471,400	545,353,300	454,795,700
Consigned to P. G. & E. Co., Newark	470,318,400	475,826,400	401,901,600
Delivered to P. G. & E. Co., Tuolumne	8,481,000	13,033,000	4,529,000
Used in Power Houses	902,855	1,002,160	1,063,150
Used in Mountain Division	240,500	243,200	243,800
Used on Foothill Division	8,330,650	11,332,650	6,381,500
Used on Coast Range Division	....	1,180,000	5,553,500
Losses and Unaccounted for	37,197,995	42,735,890	35,123,150
Total Power	525,471,400	545,353,300	454,795,700

It will be noted that the output of the past year was less than that of previous years, for reasons given later.

Rainfall and Run-Off:

In the last annual report it was stated that the snow pack during the winter of 1927-28 was only 40% of normal. This resulted in a decreased run-off during the summer months which necessitated an earlier and heavier draft from the stored water at Hetch Hetchy and Lake Eleanor. In normal years rains during the autumn and early winter produce enough run-off to augment the storage sufficiently to allow the continued operation through the winter until the commencement of the spring run-off. In the fall of 1928 the precipitation was abnormally low, as is indicated in the following tabulation:

Rainfall from July 1 to November 1, inches

	1925	1926	1927	1928
Eleanor Dam	3.12	1.61	6.43	.26
O'Shaughnessy Dam	4.30	.63	5.66	.29

The water in storage at Lake Eleanor had all been used by December 1st, and that in the Hetch Hetchy Reservoir by December 18th.

After the reservoirs had been emptied, it was possible to continue operation only with the water flowing in the streams. On account of the greater effectiveness of the Moccasin Power House as compared with the Early Intake Plant as much as possible of the water was diverted from the Cherry River System to a point above the Diversion Dam at Early Intake for use by the Moccasin Plant.

The depletion of Lake Eleanor and Hetch Hetchy storage this season should be no cause for apprehension as to sufficiency of our future water supply. At the present time Lake Eleanor can store 9,000,000,000 gallons of water, and Hetch Hetchy reservoir 67,000,000,000 gallons, with a combined yield sufficient for 2,000,000 people. Both reservoirs are capable of further development to give, together with one or two small additional reservoirs, an ultimate yield of 400,000,000 gallons per day, or sufficient to allow 4,000,000 people to use 100 gallons daily per person. Under the present program of power operation, we have been drawing at the rate of close to 500,000,000 gallons per day, or 25% in excess of the ultimate water development. This heavy draft is made possible by the fact that while the reservoirs have not been built for the ultimate capacity, the aqueduct was designed to carry a minimum of 400,000,000 gallons per day, and actual experience has shown that it is capable of carrying a great deal more. Advantage of this fact has been taken to develop more power than was originally contemplated. This larger amount of energy has been disposed of profitably through our agreement with the Pacific Gas and Electric Company, to the benefit of the people of San Francisco.

Even with this heavy draft of water, we have gone through the winters of 1925, 1926 and 1927 without difficulty, and with normal rainfall will be able to continue full capacity operation during succeeding years. The present storage capacities are ample to insure a delivery of water from Hetch Hetchy almost four times as great as the City is now receiving from the Spring Valley Water Company's system. They are not, however, sufficient to carry through a dry season, a draft of nearly ten times the present consumption of San Francisco.

This shortage of water was not peculiar to the Hetch Hetchy System, as similar conditions were experienced on all of the streams in the Sierra. The precipitation for the past three years is as follows:

Seasonal Precipitation in Inches
July 1st to June 30th

	1926-1927	**1927-1928**	**1928-1929**
Eleanor Dam..................	46.97	44.17	30:46
O'Shaughnessy Dam....	37.58	35.55	26.15

Although the seasonal rainfall has been below normal this year, temperature conditions have worked in our favor as an exceptionally cold winter and an unusually late spring held back the run-off so that the Hetch Hetchy reservoir did not fill until June 13, 1929, as compared with May 19, 1928, May 24, 1927, and May 10, 1926. Consequently the commencement of draft from the reservoir has been delayed until after July 8th, compared with June 27th in 1928, and June 15th in 1926. Therefore, with normal rainfall in the later months of this year, there is no reason to expect difficulty in maintaining continuous operation of both plants during the winter of 1929-1930.

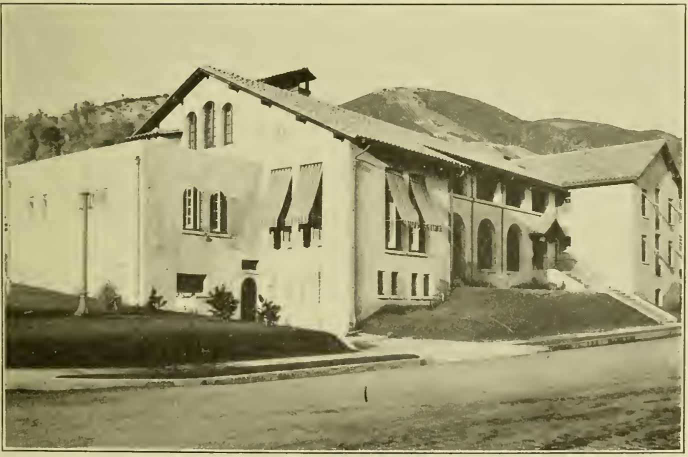
Early Intake Power House:

During the enforced shut down of the Early Intake Power House in order to work on the aqueduct, the mechanical and electrical equipment was thoroughly overhauled and put in first-class condition, which has made it possible to operate the plant during the period of high water at 10% overload.

Moccasin Power House:

The depletion of storage and the low rate of stream flow during the winter made it impossible to operate at any time during the low flow period more than three units in the Moccasin Power House. This gave an excellent opportunity to clean and inspect the generating equipment, as it was possible to take a unit out of service for several days at a time without loss of revenue, a thing which it had been impossible to do since August, 1925, when the plant was first placed in service. All parts were found to be functioning perfectly and only some minor adjustments and repairs were necessary to put the entire plant in first-class condition. During June, 1929, all four units operated continuously for sixteen days, without shut-down or interruption of any kind.

The work on the Moccasin Diversion Dam, the crushing of rock and sand for tunnel lining, together with the work of excavation in the bed of the proposed Moccasin reservoir have created and will create considerable dust. In order to cool the generators, they are equipped with fans which draw through them more than 50,000 cu. ft. of air per minute. This enormous volume of air flowing through the intricate passages of the electrical machinery, if contaminated with even a very small amount of



"Clubhouse," quarters for unmarried employees
MOCCASIN POWER PLANT

dust, causes in time rather heavy deposits which interfere with proper cooling. A sprinkler system which removes most of the dust from the air has been installed at the air intake openings. In addition to washing the air the sprinklers materially reduce the temperature of the incoming air. The summer temperatures at Moccasin are high, running up to 115 degrees in the shade, so that a reduction of cooling air temperature is of material benefit.

This station has an excellent operating record, which reflects credit upon the personnel. Good living quarters materially assist in keeping the morale high, and reducing to a minimum the changing or turnover of operating employees.

Transmission Lines:

The Moccasin-Newark 110,000 volt transmission line operated throughout the year without interruption to service. During the winter it was discovered that in some sections of the line where steel-reinforced aluminum conductors are employed, vibration is causing appreciable wearing of some of the aluminum wires at certain locations. This has necessitated considerable repair work, which is done at such times as the lines may be taken out of service. Experiments are being conducted with vibration dampers, with a view to the elimination of the vibration.

Considerable work was done on the 22,000 volt lines during the year. That portion of the line between Early Intake and Priest reservoir is more than ten years old, and has been crossed by several forest fires. It was, therefore, necessary to reinforce a number of the poles. Several long spans crossing deep gulches were originally made with iron wire. These have been replaced with short span construction, using copper wire, which has improved the characteristics of the line.

On the Coast Range Division the 22,000 volt line supplying power for construction purposes was extended from the East Portal at Alameda Creek to its terminus at Irvington Portal. This line has operated continuously since November, 1927, with but one exception when an interruption was occasioned by a buzzard flying into the wires. This line was equipped with extra insulation for the purpose of overcoming fog conditions, and this extra insulation has no doubt greatly improved the reliability of the service. On account of the tunnel work being conducted from shafts and the necessity for continuously pumping water to keep the workings dry, reliability of service over this line is of utmost importance.

The power is taken from the Moccasin-Newark high voltage transmission lines through the Seco Sub-station. On account of the high degree of reliability of service maintained on the high voltage line, construction work is insured equally good service, so far as the sub-station and lower voltage transmission line will permit. During the year there were no interruptions of power, except for a one-hour shut-down so programmed as not to interfere with the construction work. During this shut-down the oil in transformer high voltage bushings was replenished, and minor inspections and adjustments made.

Modesto Power Supply:

During the year the Engineer of Modesto Irrigation District made a request that he be supplied informally with information as to the possibility of the district securing energy from the Moccasin Plant for a period of approximately six months each year, beginning in September. Information as to a possible charge, safeguarding the City's financial return from the Moccasin Power House, was submitted. An interchange agreement since entered into between the District and the San Joaquin Light and Power Company seems more satisfactorily to have met their needs.

Aqueduct-Foothill Division

This division, extending from Moccasin Creek to Oakdale Portal, a distance of 16.7 mi., includes the Moccasin Reregulating Reservoir, with its two dams and by-pass conduit, 15.85 mi. of tunnels, and 0.45 mi. of steel pipe siphon across the Tuolumne River Canyon at Red Mountain Bar.

Hetch Hetchy Junction Shops:

The machine shop at this location was moved during September, 1928, to the headquarters shops of the Coast Range Division at Livermore. The shop for maintenance and repair of gasoline motor equipment was operated as usual during the year.

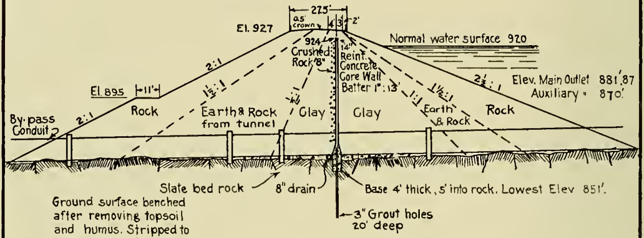
Moccasin Reregulating Reservoir:

The 10-ft. diameter reinforced conduit which will by-pass the flow of Moccasin Creek under the reservoir was extended a distance of 683 ft. upstream from the portion constructed in 1927. The total length of conduit completed to date is 1184 ft.

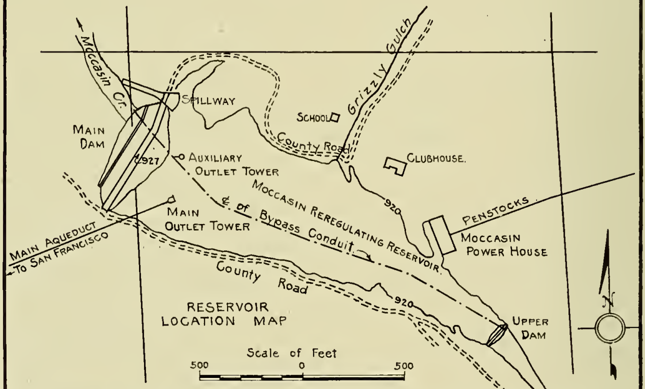
Work was begun on this 683-ft. section on July 19, 1928, when a steam shovel started the excavation of a ditch to divert the flow of Moccasin Creek and the discharge of the Moccasin Power Plant past the area on which the conduit was to be constructed. A cofferdam was built at the head of this ditch and on August 17th the excavation for the conduit foundation was started. The conduit was completed November 19th.

This section of the conduit has six temporary inlet openings located upstream from the upstream toe of the main dam, and above the cofferdam above mentioned. The cofferdam has been increased in height and strengthened. The completed portion of the conduit will carry water flowing in Moccasin Creek and impounded by this cofferdam during the construction of the main dam. It was put in use for this purpose on May 25, 1929. The temporary openings in the conduit are built so that they can be closed by stop logs from the outside and then permanently sealed with concrete placed from inside.

To divert the flow of Grizzly Gulch, a stream that occasionally carries a considerable amount of water during winter months and enters the reservoir on the north side, a canal was excavated intercepting the watercourse in the gulch and extending along the east side of the reservoir to a point of discharge into Moccasin Creek downstream from the dam. This canal is about 2400 ft. long and has a minimum depth of 4 ft. and a bottom width of 16 ft. The total amount of excavation was 18,142



MAIN DAM
CROSS SECTION.
Scale: 1" = 40'.



RESERVOIR
LOCATION MAP

HETCH HETCHY WATER SUPPLY OF THE CITY AND COUNTY OF SAN FRANCISCO, CALIFORNIA

MOCCASIN REREGULATING RESERVOIR

MAIN DAM, SECTION AND LOCATION.

DEPARTMENT OF PUBLIC WORKS. APPROVED M M O'Shaughnessy CITY ENGINEER
BY L.B.C. TRACED L.B.C. CHECKED R.L.A.
SCALE 1" = 40' & 1" = 400' DATE Sept. 12, 1929

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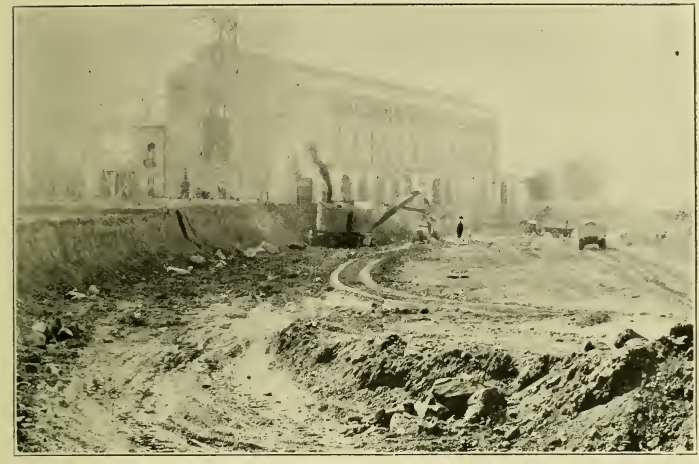
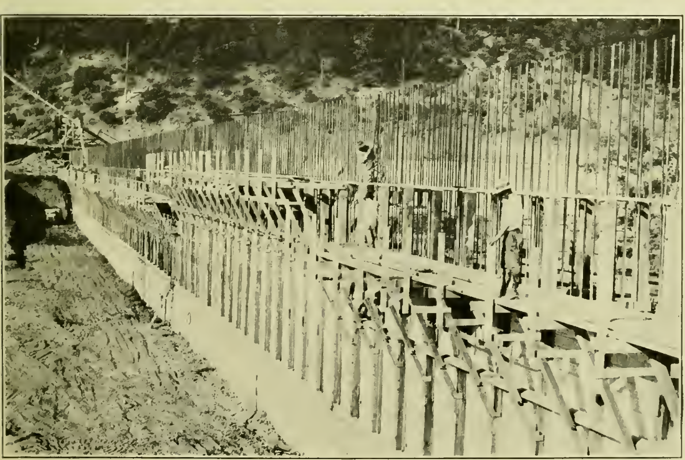


Excavating within reservoir site for material for dam



Core wall and part of fill, upstream side

MOCCASIN REREGULATING RESERVOIR MAIN DAM cu. yds., the greater portion of which was handled by steam shovel between November 3 and January 31.

A wooden bridge was built across Grizzly Gulch on the relocated County Road. This road, constructed by City forces, will replace the portion of the County Road flooded by the reservoir and will cross the valley on the crest of main dam.

During July and August, 1928, a small crew was engaged in clearing the site of the main dam, and on September 1st a steam shovel started the excavation for the concrete core wall, which excavation, after much hard work, was completed on May 1, 1929. Considerable excavation was necessary on the west side of Moccasin Creek in order to obtain a satisfactory footing on solid rock. The core wall extends the full length of the dam, approximately 830 ft., and is 4 ft. thick for the lowest 8 to 12 ft., tapers from 4 ft. to 18 in. in next 5 ft. and then tapers to 14 in. at the top and has a maximum height of 73 ft. Concreting of the corewall was started on May 9, 1929, and was still in progress as the fiscal year closed, when 1868 cu. yds. of concrete had been poured and 200 tons of reinforcing steel placed.

The damsite was stripped of soil and humus and benched to receive the fill and 1200 ft. of 8-in. diameter concrete drain-pipe was made and laid for sub-surface drains in the dam. Test pits were dug to determine the extent and quality of material available for the rolled fill. The excavation of the auxiliary control tower foundation was also completed.

Preparations are practically complete for commencing work on the placing of the earth and rock fills in the main dam. The cross section of this dam will be composed of three types of material: a rolled clay core through the central portion and surrounding the concrete core wall, a rolled earth fill next to the clay core and a rock fill on the two faces, the total fill aggregating 126,000 cu. yds.

Crest width will be 32.5 ft. at elevation 925. Upstream slope is 2½ to 1 and downstream slope 2 to 1, with a 15-ft. berm at elevation 895.

Excavation of Tunnels:

During the year the plans for driving the tunnels on this division as described in the previous annual report on pages 83 and 84 were revised in one respect. In place of using the horseshoe section (Sec. No. 1) where conditions indicated a heavy external pressure, a circular section was designed with diameters ranging from 9′-9″ to 12′-0″ to meet varying conditions. Little additional excavation was planned for the circular sections, the thickness of concrete being changed by changing the diameter of the waterway. Circular reinforced concrete sections were used near portals and other points where the earth cover was considered insufficient to offset the water pressure in the tunnel.

The total length of tunnel in the Foothill Division is 83,663 ft. (as excavated) or 15.85 mi., of which 36,887 ft. were excavated by contractors and 46,776 ft. by City forces under the direction of the City Engineer. Tunnel excavation work was carried to completion in the Moccasin heading and the Brown Adit east heading during the year. Excavation at all other points had been completed in the previous fiscal year.

At Moccasin Portal 2049 ft. of tunnel were driven from July 1, 1928, to December 6, 1928, when the tunnel was holed through to the tunnel driven easterly from Brown Adit. This distance was covered at an average rate of 394 ft. per month. Throughout this length the driving was through a hard amphibolite schist containing numerous water bearing seams necessitating a loss of 32 working days due to shut downs for grouting off the inflowing water.

The tunnel in this heading was driven as standard section No. 5, short lengths of which are being lined as described later. Work here was carried on by City forces.

The underground survey line as carried forward from Moccasin Portal for a distance of 9226 ft. was 0.45 ft. to the right of the line from Brown Adit. The tunnel grade from Moccasin Creek to the point of holing through was 0.04 ft. higher than the grade from Brown Adit and the measured distance between these points on the surface was 0.30 ft. shorter than the distance measured underground.

At **Brown Adit** 967 ft. of tunnel were driven easterly toward Moccasin Creek. Work in this heading was stopped on September 21, 1928, to permit the City forces driving from Moccasin Portal to excavate the remaining portion. The tunnel driven at this heading was through hard amphibolite schist with numerous water bearing seams. Twelve days' driving time were lost in grouting off seams. The tunnel driven during the year was excavated to Standard Section No. 5, short lengths of which will be lined.

The excavation of the tunnel from Brown Adit west to Red Mountain Bar was completed during the previous fiscal year.

Of the 18,645 ft. of tunnel driven from this point, 4600 ft. first excavated to the limits of standard lined Section No. 2, were later enlarged to standard unlined Section No. 5. During the first four months of the year 3110 ft. of tunnel were thus enlarged.

The work at this point was done by T. E. Connelly under Contract No. 113-E, which provided for excavation and timbering only. Work under this contract was completed by the end of November. Concreting of tunnel driven by the contractor was done by City forces as described later.

At **other working points** in this division, work in connection with the excavation of the tunnel, including most of the enlarging operations, was completed during the last previous fiscal year. The total excavation and enlarging done at these points is shown in tables below, with the progress for the past fiscal year.

Hetch Hetchy Aqueduct—Foothill Division
Progress of Tunnel Excavation

	Distance Driven During 1928-29 Lineal Feet East	West	Total Driven to June 30, 29 Lineal Feet East	West	Distance Between Working Points
Moccasin Portal:					
City Forces	....	2,049	....	9,224	
					21,110
Brown Adit:					
City Forces	....	....	879	903	
Contract Work	967	....	11,007	5,856	
Total	967		11,886	6,759	
					6,759
Red Mountain East Portal (Not a working point)					
Red Mountain West Portal (Not a working point)					
					1,179
Pedro Adit: City Forces	....	....	1,179*	12,575*	
					23,477
Hetch Hetchy Junction Shaft: City Forces	....	....	10,902	8,069	
					15,281
Rock River Shaft:					
City Forces	....	....	1,711	1,334	
Contract Work	....	....	5,501	5,445	
Total			7,212	6,779	
					15,857
Oakdale Portal: Contract	....	....	9,078		
Total: City Forces		2,049		46,776	
Total: Contract Work		967		36,887	
Total: City & Contract		3,016		83,663	83,663
Total in Miles		0.58		15.85	15.85

---

*Figures include 41 ft. in open cut at adit.

Hetch Hetchy Aqueduct Foothill Division
Lengths of Excavated Sections of Tunnel

	Lineal Feet	Lineal Feet	Miles
Tunnel driven to Section 2	64,204		
Tunnel enlarged from Section No. 2 to Section No. 5	28,633		
Remainder of Section No. 2		35,571	6.74
Tunnel driven to Section No. 5	18,968		
Tunnel enlarged to Section No. 5	28,633		
Total, Section No. 5		47,601	9.01
Special Section at Moccasin Portal		450	0.09
Total		83,622*	15.84

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*Does not include 41 ft. in open cut at Pedro Adit.

Tunnel Lining:

The concrete lining of the Foothill Tunnel is being placed from three plants, located at Moccasin Portal, Hetch Hetchy Junction, and Rock River. The first two are operated by day labor forces under the direction of the City Engineer and that at Rock River by A. Guthrie Company under Contract 113-C.

The method of placing the lining from all plants is essentially the same and consists of two operations. The side walls and arch of all sections to be lined are poured first, the concrete being forced into the forms by a pneumatic gun. The invert is then poured, buggies being used to transport the concrete from the mixer. Invert is screeded to exact shape by working a piece of 2″ x 4″ lumber longitudinally over templates. Collapsible steel forms are used in lining tunnel of Standard Section No. 2. Paneled wood forms are used in lining tunnel excavated to Section No. 5 and in the special circular and taper sections. Both types of forms have wooden lagging covered with sheet steel to provide a smooth surface to the lining and insure a maximum flow of water.

At all three plants, the dry aggregates, rock and sand, properly proportioned and with cement added, are hauled to a "jumbo" in special cars carrying three batches each. At Hetch Hetchy Junction and Rock River the materials are taken from the stock piles in correct proportions and conveyed to the head of the shaft on belt conveyors, where the cement is added and the dry mix is dropped down the shaft through a pipe to the batch cars in the tunnel. At Moccasin Portal the batch cars are filled at the stock piles near the portal.

The "jumbo," mentioned above, is a composite structure carried on wheels on the tunnel track and contains all equipment necessary for the handling of concrete from the delivery of the dry batches in cars to the placing of the mixed concrete in the forms. The "jumbo" consists of an incline, a conveyor, a concrete mixer and a pneumatic gun. Cars are pulled up the incline, which carries a double track, by a small hoist. Each batch is discharged in turn onto a belt conveyor which carries it to the concrete mixer. Empty cars are switched on the jumbo incline and returned to the main tunnel track. The mixed concrete is discharged directly into the gun for lining sides and arch and into buggies for lining the invert of the tunnel.

All equipment on the jumbo is operated by compressed air. Three jumbos, as described, are used in connection with the work from the three plants. The concrete guns used by the City's forces are modified Webb guns, while that used by the contractor is a Hackley gun.

In the Webb gun the concrete is dumped into the gun through a manhole, which is then closed by an air-operated device. Compressed air is then introduced through a horizontal pipe which is actuated by another cylinder and slides along with the load during discharge, thus applying the air stream to the concrete continuously through the stroke. The

Hackley gun is a shell of almost eggshaped cross section into the bottom of which the compressed air is introduced through four pipes which apply the air at four successive positions of the charge. This gun is loaded through a manhole which is manually operated. The discharge from each gun is through a six-inch pipe which carries the concrete by easy slopes and bends behind the forms at the crown of the tunnel.

Tunnel Lining From Moccasin Portal Plant:

The aqueduct tunnel from Moccasin Creek to the east slope of the Tuolumne River Canyon at Red Mountain Bar and the surge chamber 200 feet east of Red Mountain Bar are being lined from this plant.

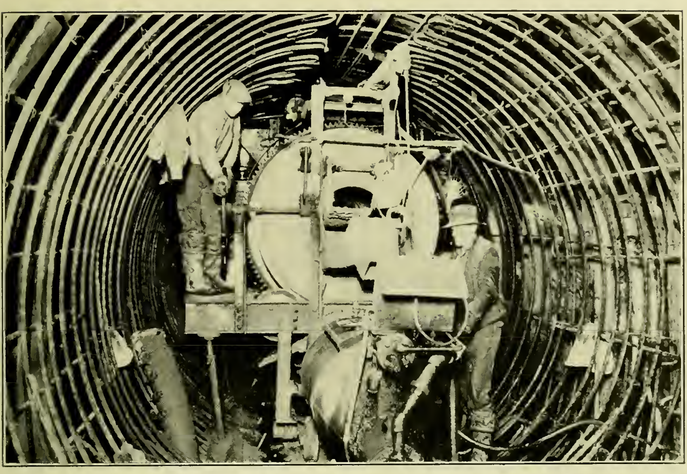
Crushed rock and sand for this work are obtained from the City's crushing plant at Moccasin Portal, described in the Annual Report for 1926-1927 on page 68. Cement is hauled by trucks under contract, from the Sierra Railway Station at Chinese over state and county roads, 10.5 mi. to Moccasin Portal.

From December 6, 1928, when the tunnel driven from Moccasin Portal holed through to tunnel driven from Brown Adit, until February 3, 1929, a small crew was engaged in enlarging 180 feet of tunnel from Section No. 2 to Section No. 5, grouting water-bearing seams, trimming tunnel, lining and repairing track and cleaning up generally in preparation for concreting. On the last date mentioned concreting of Section No. 2 was started at a point east of the surge chamber near Red Mountain Bar.

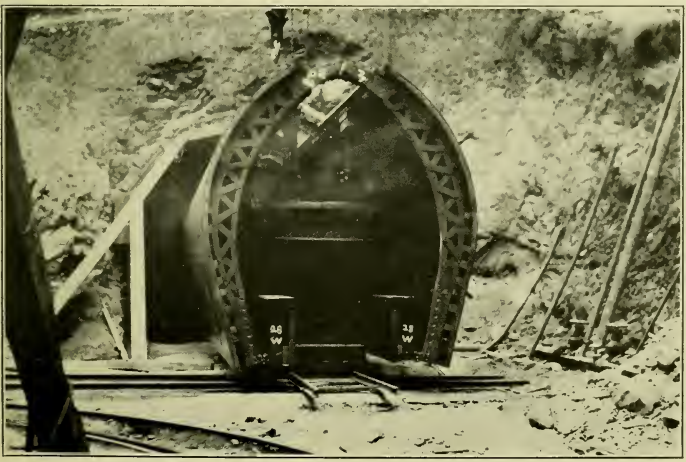
Between February 3 and the end of the fiscal year there were poured in tunnel of various cross sections, 8291 lineal ft. of sides and arch requiring 18,730 cu. yds. of concrete and 8131 lineal feet of invert requiring 3405 cu. yds. of concrete. In the special sections in the vicinity of the portals and at a point where high pressure grouting will be resorted to, reinforced sections were poured in which 162 tons of steel were placed. The concrete plug and 42 lineal ft. of lining in Brown Adit were also completed.

The following table shows the lengths of various types of tunnel sections in which sides and arch have been or are to be placed from this plant:

				Lined 1928-29	To be Lined	Total
Standard Lined Sec. No. 2				7312		7312
Lined Section No. 5					1117	1117
Taper Sections				84	19	103
10′ 3″	Circular	Section		24		24
10′ 3″	"	"	(Reinforced)	266		266
11′-4″	"	"		445	4	449
11′-4″	"	"	(Reinforced)	101		101
12′-0″	"	"	"	59		59
Total				8291	1140	9431



Concrete mixer and gun in 10′3″ circular reinforced section



Collapsible forms used in placing concrete lining in tunnel

HETCH HETCHY TUNNEL AQUEDUCT

Tunnel Lining From Hetch Hetchy Junction Plant:

Tunnel to be lined from this plant extends from Red Mountain Bar West Portal, 32,720 ft. or 6.2 mi. westerly to a point approximately midway between the shafts at Hetch Hetchy Junction and Rock River, which point is the easterly end of work under Contract 113-C. Of this distance 21,317 ft. will be lined. The aggregates for this concrete, purchased from the Atlas Rock Company, with river gravel plant at Oakdale, are delivered directly to the shaft over a spur track from the main line of the Sierra Railway.

Concrete lining from this plant was started on July 11, 1928, west of Hetch Hetchy Junction and continued with little delay until April 29, 1929, when practically all sides and arch lining was completed. Good progress was made in this work. Concreting the uncompleted invert (Sections 2 and 5) was stopped to permit the low pressure grouting to be done.

Low pressure grouting of 8273 ft. of tunnel to fill any voids outside the lining was completed between April 30, and June 21, 1929. A small amount of high pressure grouting to seal certain water bearing seams will be done later.

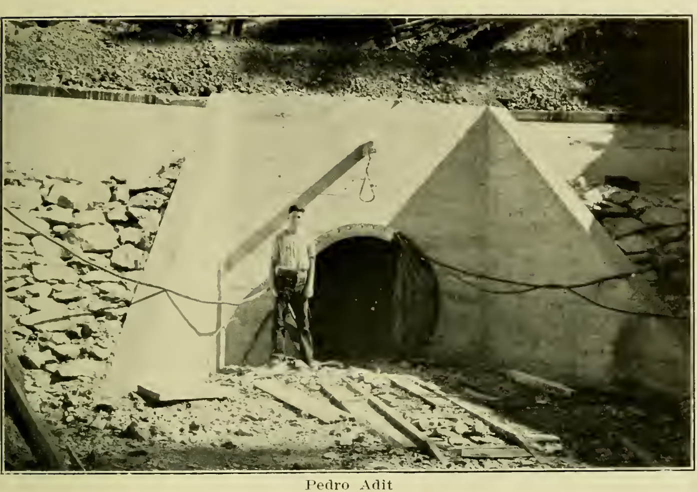
From June 21st to the end of the year the crew was employed in lining invert.

On June 30, 1929, 21,263 lineal ft. of sides and arch, and 4475 ft. of invert of tunnel of the various cross sections, including the concrete pipe section in the open cut at Pedro Adit, were poured, 229 tons of reinforcing steel being used. The total quantity of concrete poured was 50,619 cu. yds. Remaining to be poured are 54 feet of sides and arch, 16,842 feet of invert, and the lining of the shaft. The following table shows the types of tunnel section in which sides and arch have been or are to be placed from this plant:

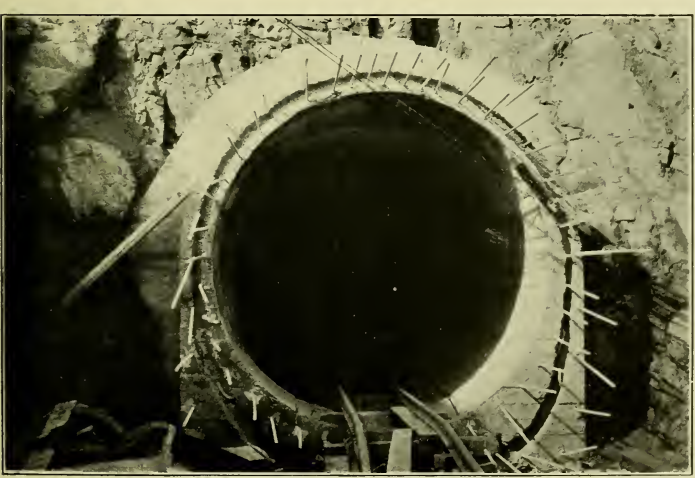
	Lined 1928-29	To be Lined	Total
Section No. 2	15,537	54	15,591
Section No. 5	2,638		2,638
Taper Sections	237		237
9′ 9″ Circular Section	459		459
10′-3″ Circular Section	818		818
10′-3″ Circular Section (Reinforced)	1,600		1,600
Total	21,289	54	21,343

Tunnel Lining from Rock River Shaft Plant:

Work from this plant under Contract 113-C by A. Guthrie & Company extends from a point approximately midway between Hetch Hetchy Junction and Rock River to Oakdale Portal, the westerly terminus of the Foothill Division. The length of tunnel excavated by the contractor was



Pedro Adit



Portal at Red Mountain Bar West

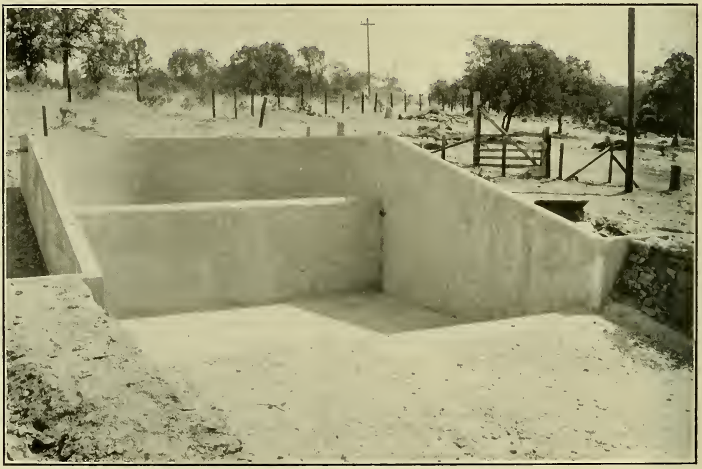
HETCH HETCHY TUNNEL AQUEDUCT

23,069 ft., of which 12,443 ft. are being lined with concrete. The contractor has also constructed the overflow shaft in the main aqueduct 1368 ft. east of Oakdale Portal.

Lining was started July 24, 1928, but the operation of the plant was not satisfactory due to the flat fractures of the crushed rock, so the plant was shut down. After alteration of several features of the plant and a change in aggregate by the addition of some river gravel, work was again started September 1, and continued throughout the year. The contractor first worked west from Rock River Shaft, completing this section on May 25, 1929, then started on the work in the east heading.

During the year 12,379 lineal ft. of sides, arch and invert or 36,626 cu. yds. of concrete, and 201.6 tons of reinforcing steel have been placed. There remain to be poured from this plant, the lining of 64 ft. of tunnel and that of the Rock River Shaft after which there will be high and low pressure grouting. The following table shows the types of tunnel section lined or to be lined from this plant.

	Lined 1928-29	To be Lined	Total
Section No. 2	6,711	64	6,775
Section No. 5	2,968		2,968
Taper Sections	185		185
9′-9″ Circular Section	824		824
10′-3″ Circular Section	1,705		1,705
Total Feet	12,393	64	12,457



OAKDALE PORTAL OVERFLOW SHAFT

Summary of Lining Progress:

Good progress generally was made in the lining of tunnels in the Foothill Division. Of 83,700 ft. of tunnel in this division, including portal structures, 51.6 per cent will be lined. During the year 97 per cent of the sides and arch and 57.8 per cent of the invert were concreted. A summary of tunnel lining progress is given in the tabulation below.

Hetch Hetchy Aqueduct Foothill Division
Progress of Tunnel Lining

	Total Lined June 30, '29 Lineal Feet	Total Concrete Placed Cubic Yards
Moccasin Portal, City Forces:		
Sides and Arch	8,291	
Invert	8,131	22,135
Hetch Hetchy Junction, City Forces:		
Sides and Arch	21,263	
Invert	4,475	50,619
Total, City Forces		72,754
Rock River, Contract Work:		
Sides and Arch	12,379	
Invert	12,379	36,626
Total:		
Sides and Arch	41,933	
Invert	24,985	109,380

Overflow Shaft Near Oakdale Portal:

The overflow shaft was constructed to guard against development of excessive internal pressures in the aqueduct during operation. The shaft is 72 ft. deep, measured from the head at elevation 821 to the tunnel invert at elevation 749 and is built directly above the main aqueduct tunnel. The inside of lining is of circular section, tapering from 10′-3″ diameter at the tunnel to 7′-0″ at 20 ft. above invert and continuing at this size to within 15 ft. of the head, where it begins to flare to the top diameter of 10 ft. Lining is 12 in. thick.

On the surface above the shaft is a stilling basin 21′-4½″ by 25′-5″ by 9 ft. deep. The flow will pass out of this basin over a weir 4 ft. above the floor into a second basin and thence down a small ravine to the left of the tunnel line. The average thickness of walls on the surface structure is 8 in. and of the floor 12 in.

The overflow shaft was constructed by A. Guthrie & Company under contract 113-C. This work was completed June 3, 1929, and involved the excavation of 195 cu. yds. of earth and rock and the placing of 244 cu. yds. of concrete with 22.6 tons of reinforcing steel.

Red Mountain Bar Surge Shaft:

A surge shaft is under construction on the main aqueduct, 205 ft. east of Red Mountain Bar East Portal. This shaft is planned to function in connection with the proposed power house at this point and also will prevent excessive pressure in the pipe siphon. The shaft and the method of excavation which was completed in May, 1928, were described in the last previous annual report.

Preparations are now under way for placing concrete lining of the shaft and aggregate is being hauled from Moccasin. A small concreting plant will be erected on the ground surface above the tunnel.

Red Mountain Bar Siphon Extension:

During the year test pits were dug along the line of this siphon to determine the profile and nature of the bed rock. A preliminary survey was made to determine the alignment and size of a wasteway conduit at Red Mountain West Portal. This work was done in connection with the design of the uncompleted portions of the siphon and appurtenances.

The portion of the siphon built in 1922 is 770 ft. in length. It consists of a 9′-6″ diameter steel pipe encased in concrete and with a thin concrete lining. Approximately 910 ft. of additional pipe is necessary to connect the tunnel and siphon on the east side of the Tuolumne River and 830 ft. on the west. This line will contain certain operating control features such as main valve, Venturi Meter, a branch outlet to the future power house on the east slope; and possibly a connection to a wasteway on the west slope.

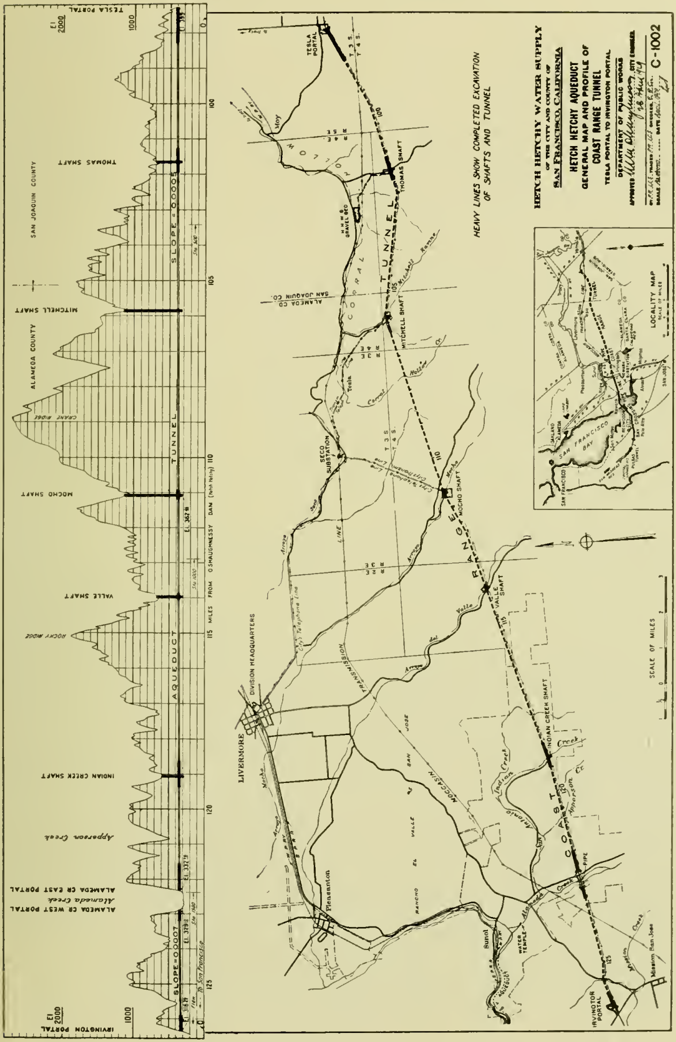
Red Mountain Bar Power Development:

The construction of a 25,000 horsepower hydro-electric power plant on the shore of Don Pedro Reservoir at Red Mountain Bar to utilize the water passed through the Moccasin Plant in excess of the demands of the City for water supply purposes, would require an investment of about $1,000,000. Preliminary studies on the possibilities of this plant were made during the year. The initial income for power from this plant, if sold at the price received for Moccasin power, would be about $500,000 annually, or one-fourth the net income received by the City for power produced in the Moccasin Plant. The income of the plant would, of course, diminish gradually as additional diversion of water to San Francisco cuts down the flow remaining for power development.

Although construction of this plant is not to be immediately undertaken, detail studies were made at this time to the extent necessary to provide for certain auxiliaries on the main aqueduct and outlets for future connection to the plant when installed.

Aqueduct—Coast Range Division

As noted in previous reports, the Coast Range Division of the aqueduct extends from Tesla Portal, 7 mi. south of Tracy, in the San Joaquin Valley, to Irvington Portal, on the edge of the Valley of San Francisco Bay. The Division consists of 28.5 mi. of tunnel and 0.59 mi. of pipe which divides the tunnel into two sections, one of 25.1 mi., the other of


HETCH HETCHY WATER SUPPLY
OF THE CITY AND COUNTY OF
SAN FRANCISCO, CALIFORNIA
HETCH HETCHY AQUEDUCT
GENERAL MAP AND PROFILE OF
COAST RANGE TUNNEL
TESLA PORTAL TO IRVINGTON PORTAL
DEPARTMENT OF PUBLIC WORKS
APPROVED M M O'Shaughnessy CITY ENGINEER
28 Aug 19
C-1002
HEAVY LINES SHOW COMPLETED EXCAVATION OF SHAFTS AND TUNNEL
LOCALITY MAP
SCALE OF MILES
TESLA PORTAL
THOMAS SHAFT
MITCHELL SHAFT
MOCHO SHAFT
VALLE SHAFT
INDIAN CREEK SHAFT
IRVINGTON PORTAL
ALAMEDA CR WEST PORTAL
ALAMEDA CR EAST PORTAL
Alameda Creek
Apperson Creek
ROCKY RIDGE
CRANE RIDGE
SAN JOAQUIN COUNTY
ALAMEDA COUNTY
SAN JOAQUIN CO.
ALAMEDA CO.
AQUEDUCT
TUNNEL
SLOPE = .00005
SLOPE = .00007
115 MILES FROM O'SHAUGHNESSY DAM (Hetch Hetchy)
LIVERMORE
DIVISION HEADQUARTERS
Pleasanton
Sunol
WATER TEMPLE
Mission San Jose
SECO SUBSTATION
Moy
Tesla
CORRAL HOLLOW
COAST RANGE TUNNEL
TRANSMISSION LINE
City Telephone Line
RANCHO EL VALLE DE SAN JOSE
PIPE
100
105
110
115
120
125

3.44 mi. The tunnel now under construction capable of carrying 300 million gallons daily will be duplicated at some indefinite date in the future by a similar tunnel 175 ft. to the south of the present one. To facilitate construction the long section of tunnel is being worked from five shafts, in addition to the portals. From each shaft a crosscut is driven 95 ft. to the present or north tunnel and 80 ft. to future or south tunnel. A small portion of the south tunnel is driven now for use for car storage, shop space and other purposes. The shaft, crosscut, and stubs of the south tunnel will be of permanent construction, lined with concrete, so as to be available in the future when the entire south tunnel is driven.

Twelve of the fourteen tunnel faces have been opened up during the past year and a total of 21,637 ft. or 4.10 mi. of tunnel driven. Four hundred five ft. of shaft have been sunk during the year at three locations, completing the sinking of the five shafts. Two additional camps have been built, one at Alameda Creek and one at Irvington Portal, with roads connecting to the highways and railroad stations.

Underground working chambers, crosscuts, stations, and rock pockets at the shafts have been excavated and concrete lining placed therein. This work is still in progress.

The crew for handling the Coast Range work has been built up from a total of 241 men on June 30, 1928, to 916 on June 30, 1929.

The construction units and progress are shown below:

Hetch Hetchy Aqueduct—Coast Range Division
Length and Progress of Construction Units

Working Point	Total Depth of Shaft Feet	Distance between working pts. Feet	Main Tunnel Driven to 6/30/29 Feet	Main Tunnel yet to be driven Feet
Tesla Portal			5,147	
		23,311		16,174
Thomas Shaft	348		E 1,990	
		22,174	W 1,353	20,821
Mitchell Shaft	812			
		27,565		26,867
Mocho Shaft	823		E 698	
		15,303	W 579	14,304
Valle Shaft	376		E 420	
		26,873	W 440	24,190
Indian Creek Shaft	301		E 2,243	
		17,139	W 1,472	12,239
Alameda E. Portal		*	3,428	
Alameda W. Portal			1,588	
		18,192		14,325
Irvington Portal			2,279	
	2,660	150,557	21,637	128,920
		28.51 mi.	4.10 mi.	24.41 mi.

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*3119 ft. of pipe to be laid.

Livermore Headquarters:

On the six-acre tract of land leased from the Southern Pacific Company at Livermore, a machine shop and electric shop building, 54 ft. by 81 ft., of frame construction, with galvanized iron covering, has been erected. The machine shop equipment installed consists of 2 overhead cranes, 1 12 x 35 Norton Grinder, 1 No. 1 Catlin Key Seater, 1 Landis Bolt Machine, 1 No. 2½ Rockford Milling Machine, 1 Racine Power Hack Saw, 1 Blount Emery Wheel, 1 20″ Barnes Drill Press, 1 4-ft. American Radial Drill, 1 28″ American Shaper, 1 200-ton Hydraulic Press, 1 16″ Springfield Lathe, 1 24″ American Lathe, and 1 36″ Putnam Lathe. Compressed air is furnished by an electric-driven 10″x10″ Sullivan Compressor.

All necessary attachments and small tools for the above equipment were purchased at the time of installing the equipment.

All overhauling and major repairs to tunnel equipment are done at the Livermore shops. During the year six air-driven mucking machines have been almost entirely rebuilt.

Equipment in the electric shop consists of small drills and hand tools, with the necessary instruments for testing out the equipment. All batteries, storage battery locomotives, motors, etc., transferred from other divisions of the Hetch Hetchy Water Supply or purchased secondhand, are overhauled or repaired here as necessary before being sent out to the camps.

Material Yard at Livermore
COAST RANGE TUNNELS

All blacksmith work necessary for work in machine and electric shops is done in a shop, 26 ft. by 54 ft., of frame construction with corrugated iron covering, which has been built for heavy blacksmithing. The equipment consists of an Erie air-operated power hammer, forges, hand tools, etc.

The facilities and equipment of the carpenter shop and woodworking yard have been increased during the past year by the addition of a portable table saw and band saw.

All forms for concrete work in the shafts, crosscuts, and stations were made here, as well as all framing of timber tunnel sets. Portable bunkhouses have been framed in the shops and hauled to camps for erection.

A steel bending shop with necessary electrical power equipment has been installed and all reinforcing steel has been cut and formed to design in the yard at Livermore and hauled by truck to the various camps for installation. This shop is capable of handling reinforcing steel up to 1¼ in. diameter. The equipment consists of power shear, radial bending table, and rolls for forming bars to circular curves.

An office building of frame construction has been built to house the engineering and accounting crew, thus releasing for storage of material and supplies the space in the warehouse previously used for office purposes.

Sunol Yard:

At Sunol, on property leased from the Southern Pacific Company, a carpenter shop and storage yard has been established, to handle tunnel timber destined to tunnel camps in that vicinity. This makes a saving of long truck hauls, with resulting reduction in costs and delivery to the camps.

The equipment consists of an electric-driven cutoff saw with 36-in. saws, and a portable table saw.

This material yard supplies the camps at Irvington, Alameda Creek, and Indian Creek. Tunnel timber sets are framed and lagging cut in the shop before being sent to camps.

Surveys:

Precise surveys of alignment and levels have been carried on during the greater portion of the year to establish and check monuments for controlling the underground surveys. The survey party on this work also checks all underground survey data as established by the instrument men working at the various camps. Surveys were made of roads and camp sites at Alameda Creek and Irvington Portal.

Right of Way Acquisitions:

Property at Alameda West Portal and at Irvington Portal for right of way and dumping ground has been acquired in fee together with easement for 1.1 mi. of aqueduct and transmission line between the above two points.

Right of way for a roadway between Carbona Station and Tesla Camp, for a distance of one mi., was secured by purchase in fee.

Roads:

A road, running southerly, four mi. in added length between Carbona Station and Tesla Camp has been constructed and graveled, the City working in conjunction with San Joaquin County on the portion which is county road.

From Moy Station to a point near Thomas Camp a road has been graded and surfaced to shorten the haul to Thomas and Mitchell Camps. This road required the building of three wooden bridges and some fairly heavy grading.

Between Alameda East and Alameda West Portals a truck road and a narrow-gauge industrial railroad have been built for a distance of 4100 ft. These roads required the building of 1100 lineal ft. of trestle work.

From the State Highway, near Irvington, a road about one mile in length to Irvington Portal Camp has been graded and gravel surfaced. On this road, where heavy cuts were necessary, a gas-air shovel was used.

Camp Water Supplies:

Tesla Camp, which is located 7 mi. due south of Tracy, is on a semi-arid slope of the San Joaquin Valley, in a locality with practically no water. At this point a well of the gravel-encased type was sunk to a depth of 700 ft. and a sufficient supply of water secured. A deep-well pump has been installed which, with the aid of a small booster pump, places the water in tanks well above the camp buildings for camp and tunnel use.

The Corral Hollow Wells, which supply Thomas and Mitchell Camps, have had the supply enlarged for use of the gravel plant by greatly enlarging the well storage. Additional tank capacity has been provided at Thomas Camp.

The Mocho Camp water supply has been increased by pumping tunnel water to the camp tanks. A filter plant was installed to purify this water.

The pipe lines supplying Valle Camp have been extended to the Crosby Springs, which have been leased, and the water supply thus increased from 8000 gallons to 16,000 gallons daily.

Indian Creek's supply has been enlarged to take care of the increased crew, by extending a 2-in. line for a distance of two mi. to bring waters from the leased Apperson Spring.

Tanks with a capacity of 25,000 gallons, have been erected 150 ft. above the buildings at Alameda Creek and water pumped from a large well dug in the floor of the valley. A 3-in. pipe line, 3900 ft. in length, connects with the two portals.

To supply Irvington Portal, a 3-in. pipe line, following the Hetch Hetchy Aqueduct right of way, has been placed from the Spring Valley 44-in. main to tanks erected above the tunnel and camp site.

Transmission Lines:

The transmission lines previously erected have been extended east to Tesla Portal and west from Alameda Camp 3½ mi. to Irvington Portal. These lines, as previously described, are 3-phase, 22-kv lines of No. 4 7-strand copper wire on cedar poles. The right of way was cleared of all brush for a width of 20 ft.; trees liable to endanger the line were removed within a width of 100 ft. This in addition to protecting the line against damage by fire and storms facilitated the handling of the materials during construction.

Camp Substations:

Electric power substations have been installed as follows: A substation of 600 kv-a capacity at Alameda Creek Camp to serve the two portals; one of 300 kv-a capacity at Tesla Portal, and one of 300 kv-a capacity at Irvington Portal.

The greater part of the machinery used in connection with tunnel driving is electrically operated, except for drills, mucking machines and a few other items operated by compressed air. Even the air-operated equipment is indirectly operated by electricity, since the compressors are electric motor driven. All camps and underground workings are lighted by electricity and electric power is used for firing the blasts in the tunnels.

Telephone System:

The telephone system has been extended east to connect to Tesla Camp and from Alameda Camp westerly 3½ mi. to connect to Irvington Portal Camp. This line consists of a metallic circuit of No. 9 EBB galvanized iron wire, on cedar poles. It follows closely the tunnel aqueduct line and gives direct connection with the Livermore Headquarters office.

Telephone lines have been established down all shafts and along all tunnels driven, to give communication continually with the work as it proceeds. This facilitates the handling of materials to the work.

Gravel Plants:

Gravel beds have been located, tests made and land for same secured at Corral Hollow, Valle Camp, and Alameda Camp.

The pits have been stripped and a small screen and bunker erected at Corral Hollow.

A portable gravel plant is to be purchased to handle the material at the above mentioned pits for preparing sand and gravel for concrete lining in the tunnels.

Tunnel Construction:

Tesla Portal: The open cut approach to Tesla Portal was excavated in the previous fiscal year and described in the report for that year.

During the year 1928-29, tunneling begun at this portal has been carried on continuously at a good rate of progress.

Camp buildings have been erected and equipment installed. The camp consists of the following:

1 combined dining room and kitchen
1 combined office and warehouse
2 bath houses
1 large bunkhouse
15 5-man bunkhouses
1 combined blower and compressor house
1 combined blacksmith shop and machine shop
1 cap house
1 primer house
1 powder house
1 oil house
1 2-car garage
1 pump house

Equipment in general consists of 1 compressor, 1 4-ton battery locomotive, 1 No. 5½ Roots blower, 1 Braun cooling tower, 1 air operated drill sharpener, 1 air driven Conway mucking machine installed last week in June. A 1½-ton automatic ice machine is used for refrigeration purposes.

Tunnel driving was started on September 6, 1928, and on June 30, 1929, 5147 feet had been excavated. Continuous timber lining has been necessary. Tunnel sets of 8″ x 8″ timber on 5-ft. centers, with 2″ x 12″ lagging in the roof only, have been used throughout. Material encountered has been gravel embedded in clay, compressed sand, and soft sandstone. Ninety-five per cent of the excavation has been done with air spades without use of powder. Toward the end of June a small flow of water amounting to 6 gallons per minute was encountered. Previous to this time, the tunnel was dry.

Thomas Shaft: At Thomas Camp during the year camp buildings were completed and additional equipment installed.

The camp now consists of the following:

1 combined kitchen and dining room
1 combined office and warehouse
38 5-man bunkhouses
2 bath houses
1 cap house
1 primer house
1 powder house
1 combined compressor and hoist house
1 cement house
1 oil house
2 garages, capacity 14 cars
1 combined blacksmith shop and machine shop

Equipment in general consists of:

1 headframe
1 Braun cooling tower
2 air compressors
1 150-H. P. Joshua Hendy Iron Works electric hoist
3 electric driven Conway mucking machines
2 battery locomotives with batteries
1 battery charging set
1 1½-ton automatic ice machine for refrigeration
2 No. 5½ Roots blowers
1 Plymouth gasoline locomotive on the dump

Concrete lining of rock pocket, skip tender's station, tunnel station, and shaft was completed on September 28, 1928. Excavation of the cross-cut was started on October 19 and completed on November 17, 1928. The excavation of the main (north) headings, east and west, started on November 20, 1928. On June 30, 1929, the east heading had been advanced 1990 ft. and the west heading 1353 ft. The south tunnel and south portion of the cross-cut have been gunite lined and the north cross-cut lining is about 25% completed. Water in varying amounts has been encountered. At present approximately 45 gallons of water per minute is being pumped from the west heading and very little from the east heading. The regular station pumps have not been installed but water is handled by electrically driven triplex pumps from the sump to the surface. Water entering from behind the concrete lining is pumped by an electrically driven triplex pump and used for camp purposes to augment the supply from Corral Hollow Wells.

Material encountered has been a soft sandstone and clay formation which develops great pressures.

The tunnel is timbered throughout and preparations are now being made to concrete close behind the driving operation.

Mitchell Shaft: During the year at Mitchell Camp additional camp buildings have been erected and additional equipment installed.

The camp now consists of the following:

1	combined dining room and kitchen
2	bath houses
1	combined compressor and hoist house
1	blower house
1	combined office and warehouse
27	5-man bunkhouses
1	cap house
1	primer house
1	powder house
1	cement shed
1	combined blacksmith shop and machine shop

Equipment in general consists of:

1	77-ft. headframe
1	150-H. P. electric hoist
2	air compressors
2	American blowers
1	Braun cooling tower

Shaft sinking has been carried on from the 524-ft. level to the bottom of the shaft at a depth of 812 ft. The formation is a shattered schist, developing heavy pressure, and is difficult to handle. To resist this pressure the lower part of the shaft has been lined with concrete to a section circular in plan.

Skip tender's station, rock pocket, station and working compartments have been excavated and concrete lining placed.

The shaft is now lined with concrete at various points for a total distance of 137 feet.

During the sinking operation considerable water was encountered, requiring grouting with cement. The previous report (1927-28) gives detail on the work at Mitchell Shaft.

Mocho Shaft: Mocho Camp has been enlarged during the year to accommodate a full tunnel crew and the plant increased to handle tunnel driving. It now consists of the following:

1 combined dining room and kitchen
30 5-man bunkhouses
1 combined office and warehouse
1 electric shop
3 bath houses
1 combined hoist and compressor house
1 steam compressor house
1 combined blacksmith shop and machine shop
1 blower house
1 oil house
1 cap house
1 primer house
1 powder house

Major items of equipment consist of:

1 77-ft. headframe
1 150-H. P. electric hoist
1 standby steam compressor plant
1 Braun cooling tower
2 electrically driven air compressors
2 No. 5½ Roots blowers
2 air operated Conway mucking machines
2 battery locomotives with batteries
1 battery charging set
1 3-stage, 200-H. P. electrically driven station pump
1 Ford gasoline locomotive on dump

Rock pocket, station, pump sumps, cross-cut and working compartments in the south tunnel have been completed and concreted. Large electrically driven station pumps have been installed to handle the water encountered in the tunnel, which at present amounts to 190 gallons per minute.

Tunnel is now driven for a distance of 698 ft. in the east heading and for a distance of 579 ft. in the west heading, or a total of 1277 ft.

The formation at this shaft is broken up schist of varying degrees of hardness. Timbering is required throughout this work.

Valle Shaft: This shaft is located 9 mi. south of Livermore on Arroyo del Valle. Camp equipment and buildings have been enlarged to handle the tunnel work and now consist of the following:

1 combined dining room and kitchen
1 combined office and warehouse
26 5-man bunkhouses
2 garages, capacity 14 cars
2 bathhouses
1 hoist and compressor house
1 machine shop and blacksmith shop
1 blower house
1 cap house
1 primer house
1 powder house

Major items of equipment consist of:

1 headframe
1 Braun cooling tower
1 150-H. P. electrically driven hoist
2 air compressors
2 No. 5½ Roots blowers

The shaft was excavated to full depth of 376 ft. on August 18, 1928. The rock pocket, station, cross-cut, south tunnel working compartment and pump sump were then excavated and concrete lining placed.

This shaft is in soft, blocky sandstone carrying large quantities of water. Grouting operations, with cement grout, were carried on continuously after reaching 100 ft. depth. Five to seven pilot holes 2-in. diameter, drilled to a depth of 35 or 40 ft. below the bottom, were used for forcing in cement grout under a pressure of 150 to 250 pounds per sq. in.

After completing working compartments, the shaft was concrete-lined for the full depth.

Tunnel has been driven from this shaft for a total distance of 860 ft. in sandstone formation, with full timber lining.

Indian Creek Shaft: At Indian Creek Shaft, located on the headwaters of San Antonio Creek, additional buildings have been erected and additional equipment installed to handle the tunnel work. The camp now consists of the following:

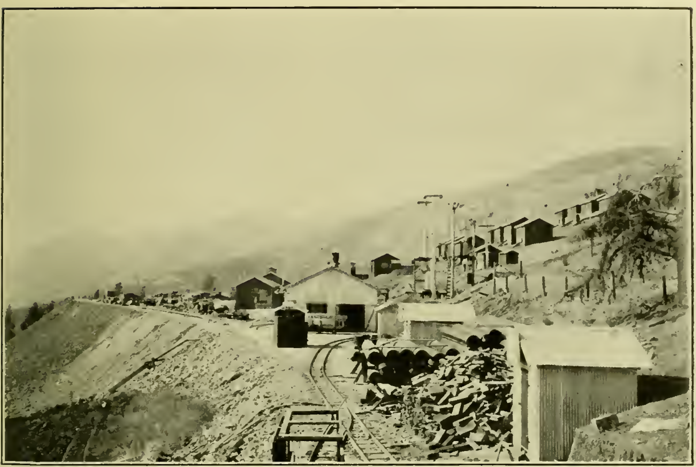
1 combined dining room and kitchen
1 combined office and warehouse
1 combined hoist and compressor house
1 oil house
1 cap house
1 primer house
1 powder house
2 bathhouses
1 garage, capacity 12 cars
30 5-man bunkhouses
1 blower house

Major items of equipment, much of which was released from the tunnel driving operations of the Foothill Division, comprise:

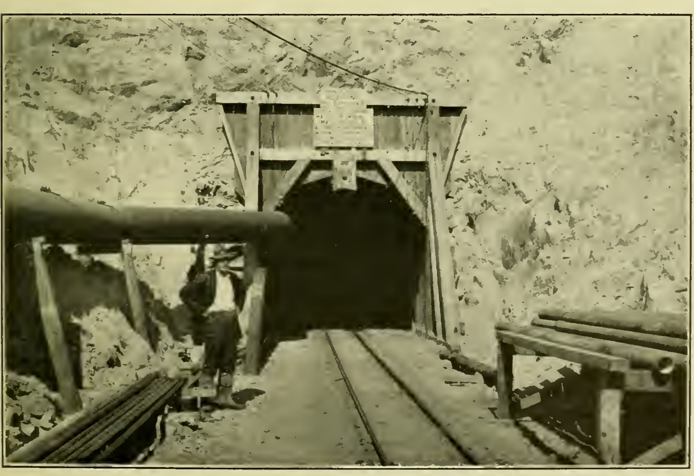
1 150-H. P. electric hoist
1 Braun cooling tower
1 ¾-ton refrigerating plant
2 air compressors
2 air operated Conway mucking machines
2 battery locomotives with batteries
1 Plymouth gasoline locomotive on the dump
2 No. 5½ Roots blowers
1 motor-generator charging set

The sinking of the shaft was completed to full depth of 301 ft. on July 21, 1928. Reinforced gunite was used for lining the shaft and making the spreaders of the shaft sets, thus avoiding the use of timbers.

Rock pocket, station, cross-cut, pump sump, and working compartments in the south tunnel, were excavated and lined with concrete. Vari-



Dump and yard. Typical camp on hillside



Tunnel portal

COAST RANGE TUNNELS, IRVINGTON PORTAL

ous types of circular reinforced and unreinforced concrete test sections were poured in the south tunnel and used for a series of exact deflection measurements and strain gage measurements to determine earth pressures.

Tunnel has been driven in an easterly direction for a distance of 2243 ft. through a formation of gravel embedded in clay and developing considerable pressure. To the westward the tunnel has been driven 1472 ft. in broken shales bearing a small amount of water, and also developing pressure. Both headings require timber lining throughout.

Alameda Creek: In the Alameda Creek valley, midway between Alameda East Portal and Alameda West Portal, a camp has been centrally erected to handle the tunnel driving and gravel plant operations in both east and west direction. This camp is 3 mi. south of Sunol, which is served by the Southern Pacific and Western Pacific railroads.

A narrow gauge tramway connects the camp with the two portals, which are approximately 3000 ft. apart.

The camp consists of the following buildings:

1 combined dining room and kitchen
1 combined office and warehouse
1 temporary dining room, 14′ x 18′ at West Portal
30 5-man bunk houses
2 garages, capacity of 14 cars
1 bathhouse
1 compressor house and machine shop
2 blower houses
1 cement house
3 oil houses
3 cap houses
2 primer houses
1 powder house

Major items of equipment consist of:

2 air compressors
2 No. 5½ Roots blowers
4 Meyers-Whaley mucking machines
3 4-ton battery locomotives with batteries
2 charging sets for charging batteries

Alameda East Portal cut, 180 ft. long and running to an extreme depth of 59 ft., requiring the removal of 5330 cu. yds. of material, was completed June 30, 1928.

Tunnel driving was started November 3, 1928, and has been carried in 3428 ft. The formation is sandstone, carrying large quantities of water. One flow of 2500 gallons per minute was encountered.

The total flow averages 965 gallons per minute. Considerable delay has been caused by water and the grouting of waterbearing seams. Bunkers with gravel elevator have been erected as part of preparations to pour concrete lining in this section.

At **Alameda West Portal**, inauguration of work was delayed until December 26, 1928, by difficulties in acquiring right of way through the

Roney property. The excavation of 5160 cu. yds. in open cut, handled by gas-air shovel and dump trucks, completed on January 26, 1929, was followed immediately by tunnel driving. The heading has been advanced 1588 ft. through broken shale and clay, requiring timbering throughout with 10″ x 10″ or 12″ x 12″ sets.

Irvington Portal: Irvington Portal cut, 160 ft. in length and running to an extreme depth of 55 ft., was completed October 23, 1928. This cut, and work on the road leading to the camp, were excavated by gas-air shovel.

Due to steep slope of the adjacent hillsides, it was necessary to do considerable grading for the camp site and placement of equipment. Material taken from the portal cut and tunnel excavation was utilized for fill for this purpose.

Camp construction and installation of equipment were started on November 20, 1928. The camp consists of the following buildings:

1 combined dining room and kitchen
1 combined office and warehouse
18 5-man bunkhouses
2 bathhouses
1 pump house
2 garages, capacity 8 cars
1 combined machine shop and compressor house
1 oil house
1 cap house
1 primer house
1 powder house

Major items of equipment consist of:

2 Meyers-Whaley mucking machines
1 motor generator set for charging batteries
1 ¾-ton refrigerating plant
1 battery locomotive with battery
2 air compressors
1 No. 5½ Roots blower

Tunnel driving with a full crew started on February 15, 1929, and the heading has been advanced 2279 ft. This tunnel is in sandstone and shale formation and carries considerable water. Grouting has been used with fairly good success to shut off the water flows.

Bay Development and Peninsular Reservoirs

The Bay Development, including Pulgas Tunnel and the completed portion of the Bay Crossing Pipe Line has been in constant use by Spring Valley Water Company during the fiscal year under lease from the City, which receives an annual rental of $250,000 for its use.

Owing to the very light rainfall and consequently smaller run-off for the season the pipe line has carried less water from Niles Reservoir to Crystal Springs Reservoir than in the last two preceding years. The average daily delivery through the City's aqueduct for the year was 15.3 million gallons as against 23.6 for the previous year; the maximum was 24.8 million gallons daily during September, 1928, while the minimum, in

July, 1929, was 5.4 million gallons daily against a capacity of 43 million gallons daily.

During the fall and winter the Company drew down Calaveras Reservoir to a very low level in anticipation of the spring run-off, which, however, proved exceptionally light. This reservoir is consequently very low at the end of the fiscal year, as shown in the following table:

Water Stored in Spring Valley Reservoirs

	Capacity	Water in Storage June 30		Storage 6/30/29 as % of Capacity
		1928	1929	
	Millions of Gallons			
Reservoirs:				
Peninsular System:				
Crystal Springs	22,512	14,212	10,696	47
San Andres	6,230	3,107	2,630	42
Pilarcitos	1,031	696	284	28
Total: Peninsular	29,773	18,015	13,610	46
Alameda System:				
Calaveras	32,780	7,694	1,844	6
Total: Peninsular and Alameda	62,553	25,709	15,454	25

City Reservoirs:

During the year one parcel of land consisting of three small lots in the Glen Park Reservoir Site was acquired.

Included in the properties to be acquired in the Spring Valley Purchase is a tract of 41.73 acres fronting on Ocean Avenue adjoining the Westwood Park subdivision. This tract, known as the Balboa Park Reservoir tract, will be used for one of the three large City reservoirs to be constructed in the future.

Acquisition of the Spring Valley Water Company's Property

On May 1, 1928, the voters of San Francisco by a four-to-one affirmative vote authorized a bond issue of $41,000,000 to finance the purchase of the properties of the Spring Valley Water Company required by the City for water supply purposes. The Board of Supervisors, by Resolution No. 28945, approved May 18, 1928, directed that "the City Attorney and the Board of Public Works, through its Engineering Department . . . proceed forthwith with all preliminary work necessary for the taking over by the City of all and singular the properties to be acquired from the Spring Valley Water Company." The work done by the City Engineer's Office in accordance with this Resolution, is described below:

Sale of Bonds:

During November, 1928, the members of the Public Utilities Committee of the Board of Supervisors, in conference with the City Engineer and City Attorney, agreed on February 1, 1929, as a tentative date for taking over the properties of the Spring Valley Water Company. The intervening period was to be used in completing the audit of Company's accounts, taking of inventories and preparation of the deed conveying the Company's properties to the City. This work was in progress in November.

On January 14, 1929, the date set for receiving bids for the "Spring Valley Bonds," no bids were received, financial conditions in general making 4½% bonds unsalable at par. In an effort to dispose of the bonds at the earliest possible date, they were placed in the hands of the City Treasurer to be sold "over the counter" at par value plus accrued interest to any buyer or group of buyers who would purchase the whole issue. At the close of the fiscal year the bonds had not been sold.

The failure of the bond sale necessarily delayed the date for taking over the Company's property. However, the work done in this connection was useful for the ultimate purchase and carried on to the original date set with the view to establishing complete records which could in the future be brought down to the actual date of transfer with a minimum of time and effort.

Nature of Work Done:

A tremendous amount of detail work was required in preparation of the deed with descriptions of the property to be taken by the City, and in the audit and inventory work incidental to the determination of the price to be paid for the property. This work occupied a period of about six months from August, 1928, to February, 1929, and cost in round figures $13,000. The greater part of it was done by men from my staff in the Company's offices, for convenience of reference to the many record books, maps and document files.

The Deed:

In 1913 the City filed a complaint in eminent domain against the Water Company as a step in proceedings to acquire the properties designated by the City Engineer as necessary for use in connection with the water supply of San Francisco. The property descriptions contained in this complaint prepared by representatives of the City and the Company, collaborating, were revised in 1921 and incorporated into the Company's offer of that year to sell its properties to the City. The option to purchase its property given the City by the Company in 1922 in accordance with an order of the California State Railroad Commission referred to these 1921 descriptions, which accordingly were used as the basis for the preparation of the present deed descriptions.

In the preparation of the deed the 1921 property descriptions were thoroughly checked, revised and in some instances rewritten. The method used in this work involved many detail operations, some of which are outlined in the following:

1. All deeds and McEnerney decrees were examined as to sufficiency

and character of title, and encumbrances, and descriptions were checked against a set of maps prepared for this purpose.

2. The descriptions in the 1921 offer were then checked against these maps; the descriptions of City lands were also compared against City Engineer's Office record.

3. The deed then prepared was reviewed by officials of the company, the City Engineer's Office and the City Attorney's Office.

4. All dates and recording data of instruments and filed maps referred to in the deed were verified by an examination of County Recorders' Records.

5. As a final check, after the deed was typed and proof-read, it was checked against the Company's maps and deed lists.

All title reports and other documents were examined by the City Attorney's representative, assisted by employees of this office. He also prepared the general clauses of the deed and reviewed the latter, section by section, as the work progressed.

The City will take title to the Company's properties by a grant, bargain and sale deed subject to certain reservations and conditions. The deed, which comprises 183 pages of single-space typing on letter size paper, includes all property of the Company to be acquired by the City as of February 1, 1929. The amount of real property to be acquired in the several counties is as follows:

San Francisco City and County	63 parcels	968	Acres*
San Mateo County	50 parcels	23,775	"
Alameda County	34 parcels	24,267	"
Santa Clara County	8 parcels	13,602	"
Total area of real property		62,612	Acres

*Includes 45 acres of the Lake Merced Rancho in San Mateo County.

As the properties to be acquired are described in the deed as of February 1, 1929, some revision will be necessary to take into account any changes that may occur between that date and the actual date of conveyance.

Audit of Accounts:

Under the terms of the option of April, 1922, purchase price of the property to be acquired as at March 1, 1920, is fixed at $37,000,000. The price actually to be paid will be determined as directed by Railroad Commission orders, by adding to this base the amount of capital expenditures from March 1, 1920, to the date of purchase, and deducting the amortization and depreciation fund contributions for the same period. Various other adjustments will be made, including one for changes in inventory of stock on hand.

To check the Company's figures a thorough audit of the Company's accounts was made, going back to March 1, 1920. The accounting firm of William Dolge and Company was engaged for this purpose.

The work done involved a detailed examination of all capital accounts and a survey of all other accounts in order to determine the proper credits to the amortization fund and other adjustments to the base purchase price. Charges to capital accounts were verified by reference to vouchers, paid checks, payrolls, material records, contracts and other data. Sufficient tests were made of the records to prove a proper segregation of materials and labor. All contracts were reviewed and found in order, as were all real estate transactions and accounts.

The following is a statement of the purchase price determined as of December 31, 1928:

Base price fixed in option; value set by California State Railroad Commission as at March 1, 1920	$37,000,000	
Plus cost of additions and betterments to Company's system from March 1, 1920, to December 31, 1928	8,137,380	
Total		$45,137,380
Deductions		
Amortization Fund maintained in accordance with Railroad Commission Orders	$ 2,979,781	
Depreciation Fund maintained in accordance with Railroad Commission Orders	2,200,000	
Sale of Lands included in option	17,650	
Total deductions		$ 5,197,431
Total Option Price as of December 31, 1928		$39,939,949
Plus unpaid balance of the $1,000,000 Loan to City		360,435
TOTAL PURCHASE PRICE		$40,300,384

The purchase price shown above is subject to slight adjustments at the actual date of taking over the properties.

Inventories:

As part of the audit and in behalf of the City, as buyer, the accountants and members of the City Engineer's Office participated with the Company in taking the yearly inventory of stock which they were making as a regular annual procedure on November 30, 1928. This inventory was to be brought down to the date of purchase through book adjustments.

Representatives of the City were present and assisted in all stages of preparation of this inventory with a view to arriving at an exact determination of the value of the stock, and the establishment of a permanent record of the materials to be acquired. This last requirement will not be completed until the date of acquisition of the property.

The Company maintains stocks of pipe, pipe fittings, meters, automobile accessories and supplies, new tools and miscellaneous supplies at warehouses in the three divisions of its system and at several yards in San Francisco. All of these locations were visited while making the physical inventory.

The Company does not keep stock records of furniture, office equipment, fixtures and appliances, used tools and construction equipment and shop equipment and machinery, so the City made a separate inventory of these.

This furniture, tool, and equipment inventory was made during the month of January and involved a complete inspection of all buildings, yards, pumping stations, reservoirs and other features of the Spring Valley System. All items not otherwise recorded or inventoried were taken in this inventory and a permanent record made.

The furniture, tool and equipment inventory can readily be brought up to the date of acquisition as the changes will not be numerous, but it will be necessary to take a new physical inventory of stock as the time since the date of counting is too long and the turnover too large to warrant the use of the count of November 30, 1928.

Personnel:

Matters affecting the transfer of properties and future operation of the system received close personal attention of the City Engineer and his Chief Assistant, as well as City Attorney O'Toole and Assistant City Attorney John J. Daily. Valuable assistance was rendered by N. Randall Ellis, Valuation Engineer; Wm. Dolge, C. P. A.; Willis O'Brien, Auditor, H. H. W. S.; and L. W. Stocker, Assistant Engineer.

Peninsular Water Supply Investigation

The investigation of water supply of the San Francisco peninsula from Daly City to Palo Alto by M. J. Bartell, Hydraulic Engineer of this office, noted in last year's report as being under way, was completed in January, 1929. This study was made to determine what provision must be made in the City's Hetch Hetchy-Spring Valley System to take care of these communities' requirements for water.

The conditions revealed should be cause for grave concern for the officials and residents of the several communities on this peninsula. More than 30 agencies are engaged in the distribution of water, which is taken largely from subterranean sources. The rapid increase in population and in demand for water has depleted the underground storage so that in the last 16 years the water table, or level of the subsurface water, has lowered in varying degrees in the several localities, to a maximum of 73 ft. at Redwood City. Many wells formerly fresh, are now yielding saline water. The draft exceeds the safe yield by more than 50 per cent. Estimates of the water required for the increasing population indicate that these communities will use from the City's water system 19 million gallons daily in 1940 and 60 m. g. d. in 1950.

A Citizens Water Committee in San Mateo, consisting of representatives of the various communities, appointed a committee of engineers, resident and practicing in the peninsula area, to study the water situation. Palo Alto was not represented and the committee's report does not deal with it. For the remaining area the committee reports:

"(1) Local sources of water supply have been practically exhausted. The future water supply must come from the Hetch Hetchy-Spring Valley System and pipes must be provided for receiving and distributing the same.

"(2) The best method to bring about this result is the formation of a San Mateo County Water District.

* * * * * * *

"(8) The Water District is therefore a very urgent immediate necessity and steps leading to its formation should be taken at once so that construction work may be started in 1930 and partial water service started in 1931."

To take care of the requirements of these areas, it will be necessary to make the first unit of pipe across the San Joaquin Valley as large as the funds will permit.

HETCH HETCHY WATER SUPPLY CONTRACTS IN FORCE DURING FISCAL YEAR 1928-1929

Contract No.	Title of Contract	Division to which Chargeable	General Description	Contractor	Date of Signing Contract	Time Allowed In Days	Date of Acceptance	Amount of Bid	Amount Paid
			1910 WATER CONSTRUCTION FUND ($45,000,000 BOND ISSUE)						
77-C	Construction of aqueduct tunnels in Mountain Division on a cost-plus-fee basis	Mountain	Aqueduct tunnel, Early Intake to Priest Portal	Construction Company of North America, 431 Mills Building, San Francisco	March 3, 1920	1000		$7,802,952°	$8,309,999
		° Actual construction completed. Formal acceptance not yet made.							
			1925 WATER CONSTRUCTION FUND ($10,000,000 BOND ISSUE)						
113-C	Construction of aqueduct tunnels	Foothill	Driving and lining tunnel in Rock River and Oakdale Sections	A Guthrie and Co., 625 Market Street, San Francisco	Sept. 29, 1926	800	Not completed	$1,257,953	$1,355,406
113-E	Construction of aqueduct tunnels	Foothill	Driving tunnel in Brown Section	Connolly and Deluca, 461 Market Street, San Francisco	Sept. 28, 1926	700	Not completed	779,745	675,193
119	Furnishing and delivering outlet gates	Foothill	Gates for 2 outlet structures, Moccasin Reregulating Reservoir	Joshua Hendy Iron Works, 200 Pine St., San Francisco	Jan. 30, 1929	100	Not completed	13,798	13,798
			1928 WATER CONSTRUCTION FUND ($24,000,000 BOND ISSUE)						
120	Furnishing and delivering Gravel Plant	Coast Range	Fully equipped portable gravel plant	(Bids to be received July 10, 1929)					

TOTALS PAID UNDER CONTRACTS

	1910 Fund	1925 Fund	Totals
Contracts completed prior to July 1, 1928 brought forward from previous report,	$17,576,263	$ 232,399	$17,808,662
Contracts completed during fiscal year 1928-1929	0	0	0
Total, contracts completed to June 30, 1929	$17,576,263	$ 232,399	$17,808,662
Contracts not yet completed	8,309,999	2,044,397	10,354,396
Total amounts paid, all contracts	$25,886,262	$2,276,796	$28,163,058

Expenditures on Hetch Hetchy Project
June 30, 1929

1909 and 1910 Bond Funds Together With Amount Advanced From General Fund Prior to Bond Issues

Code	Account	Fiscal Year 1928-1929	Total to June 30, 1929
	General Expenditures		
2001	Preliminary Water Supply Investigation		$ 140,408.29
2002	Lands, Water Rights and Rights of Way	$ 5,377.41	1,749,255.51
2003	Rentals to U. S. Government		106,018.11
2004	Legal Expenses		179,818.03
2005	Hydrography		63,879.95
2006	City Office Administration	1,599.58	450,493.58
2007	City Office Engineering	3.54	379,827.86
2009	Taxes	7,542.55	77,672.46
2012	Unamortized Expense, Sale of Bonds		26,877.36
A-16	City Engineer's Revolving Fund		20,000.00
	Total General Expenditures	$14,523.08	$ 3,194,251.15
	Construction Expenditures		
1000	Hetch Hetchy Railroad (Including Net Operation)	$ 369.20*	$ 2,742,980.28
2008	State Compensation Insurance, Undistributed		4,680.67
2010	Miscellaneous Construction Expenditures	3,088.91	25,805.29
2015	C. R. C. Evaluation, P. G. & E. & G. W. P. Co.'s Properties, San Francisco	12,434.75	355,207.66†
2017	Wells in Sunset and Richmond Districts		19,906.44
2018	Tourist Camp, Mather	283.15	52,740.31
2101	Groveland Office Administration & Engineering	158.34	258,123.27
2102	Groveland Hospital (Including Net Operation)	12.50	118,023.77
2110	Groveland Dwellings, Less Rents		68,413.77
2111	Groveland Warehouse		9,725.96
2112	Groveland Water Supply		33,784.65
2200	H. H. Div., O'Shaughnessy Dam & Appurtenances		8,161,928.83
2300	Lake Eleanor Div., Eleanor Dam and Appurtenances		391,747.22
2400	Mt. Div., Aqueduct Tunnels and Structures	693.88	10,581,956.33
2500	Priest Div., Dam, Reg. Reservoir & Power Tunnel	6,355.78	2,380,753.70
2600	Moccasin Div., Penstock Power House & Structures	288.01	4,874,065.98
2700	Foothill Div., Tuolumne R. Crossing at Red Mt. Bar		285,009.63
2800	Lower Cherry Power Development (Including Net Operation)		311,985.16
2900	Early Intake Diver. Works, Dam and Appurtenances		879,693.92
3000	Canyon Ranch & Mather Sawmills (Including Net Operation)		147,538.30

Note: Asterisk (*) denotes credits. (†) See note page 109.

Expenditures on Hetch Hetchy Project
June 30, 1929

1909 and 1910 Bond Issues and General Fund

Code	Account	Fiscal Year 1928-1929	Total to June 30, 1929
	Construction Expenditures (Continued)		
3200	H. H. Power Trans. System (Moccasin to Newark)	$	$ 1,787,294.18
3300	San Joaquin Division, Cost of Land & Surveys	....	214,454.35
3400	Coast Range Division, Preliminary Surveys	97.27	127.27
3500	Golden Rock Ditch, (Less Water Sales)	....	6,561.99
4000	Boarding House, Net Operation	....	302,351.94
5000	Materials and Supplies	25,549.65	64,213.11
6000	Bay Development (Newark to Pulgas) Incl. Lands	5,770.58	5,958,550.46
L-73	Electric Energy from H. H. Plants (Since 8/15/25)	....	287.71*
	Total Construction Expenditures	$54,363.62	$40,037,336.73
	Miscellaneous Expenditures		
A-12	Accounts Receivable — Miscellaneous Debtors	$ 187.00*	$..............
A-13	Accounts Receivable H. H. W. C. Fund (Issue of 1925)	40,809.67*	53,195.50
A-18	Remittances in Transit (Deposited with Treasurer after 7/1/29)	1,006.63*	15.00
	Total Miscellaneous Expenditures	$42,003.30*	$ 53,210.50
	Gross Expenditures	$26,883.40	$43,284,798.38
	Revenues During Construction		
500	Rental from Lands and Rights of Way	$ 3,584.26	$ 27,827.43
501	Sale of Water to Irrigation Districts	....	164,979.17
502	Use of Pipe Line, Bay Development	....	24,600.78
503	Miscellaneous Credits	142.31	8,074.32
	Total Revenues	$ 3,726.57	$ 225,481.70
	Net Expenditures	$23,156.83	$43,059,316.68

Note: Asterisk (*) denotes credits.

Expenditures on Hetch Hetchy Project
June 30, 1929

1909 and 1910 Bond Issues and General Fund

Reconciliation of Statement of Expenditures With Consolidated Statement of Funds

Disbursements As Per Consolidated Statement of Funds:				
1909 Bond Issue			$ 603,033.87	
1910 Bond Issue			42,913,614.27	
General Fund			118,219.93	
Hetch Hetchy Operative Revenue Fund		$1,967,940.94		
Transfer to Bond Interest Fund		620,000.00*	1,347,940.94	$44,982,809.01
Accounts Taken Into Expenditures As of June 30, 1929:				
(not taken up by Auditor until after July 1, 1929)				
Accts. Payable, H. H. Power Operative Fund			$42,260.03	
Accts. Payable, S. F. City Employees' Retirement System			18.27	42,278.30
				$45,025,087.31
Receipts Used As Reduction of Expenditures:				
Operation of Hetch Hetchy R. R.		$1,380,876.87		
Sale of Power, Lower Cherry Power Development		386,338.54		
Sale of Water		166,324.50		
Use of Pipe Line, Bay Development (S. V. W. Co.)	$79,155.35			
Less amount unpaid	54,554.57	24,600.78		
Miscellaneous		4,093.31	$1,962,234.00	
Non-cash credits used as reduction of expenditures			3,536.63	1,965,770.63
Net Expenditures as per Detail Statement (Page 108)				$43,059,316.68

Note: The foregoing expenditures include the sum of $355,207.66 (Account 2015, Page 107) which was paid out of the Hetch Hetchy Operative Revenue Fund for valuation of Pacific Gas and Electric Company's and Great Western Power Company's Plants. This charge is not a true Hetch Hetchy Project expenditure and should be deducted when calculating the actual costs of the project.

Note: Asterisk (*) denotes credit.

Expenditures on Hetch Hetchy Project
June 30, 1929
1925 and 1928 Bond Issues

Code	Account	Fiscal Year 1928-1929	Total to June 30, 1929
	Foothill Division		
2700	Division Administration & Engineering	$ 42,640.16	$ 171,527.75
2701	Preliminary Investigations & Surveys		31,837.79
2702	Field Engineering and Inspection	69,534.23	178,849.86
2703	Camps	26,354.69*	230,090.25
2704	Roads, Trails and Tramways	11,745.95	177,790.60
2705	Adits	5,910.91	14,331.50
2706	Shafts	14,563.50	85,076.29
2707	Aqueduct Tunnels	1,754,093.76	6,031,093.66
2708	Tuolumne River Crossing at Red Mt. Bar	891.55	891.55
2709	Aqueduct Tunnels—Main Control Tower	5,375.60	5,375.60
2710	Aqueduct Diversion Dam & Appurtenances	147,030.75	182,854.45
2711	Moccasin Creek Diversion Dam		77.09
2712	Moccasin Creek Diversion Conduit	83,929.95	146,684.64
2713	Moccasin Crushing Plant	37,289.24*	47,895.52
2714	Miscellaneous Jobbing and Sales Account	4,300.26*	8,781.58
2716	Division Machine Shops (Incl. Operation)	19,443.95*	6,646.50
2717	Division Warehouse (Incl. Operation)	2,154.37*	6,817.90*
2718	Lands & Rights of Way	4,779.99	60,912.72
2719	Power Transmission Line for Constr. Purposes	1,347.04	59,106.88
2720	Div'n. Administration Buildings & Equipment	1,221.17	55,558.38
2721	Division Hospital (Incl. Operation)	27,248.97	65,081.79
2722	Materials and Supplies	132,371.79*	126,636.81
2723	Division Misc. Shops & Equip. (Incl. Oper'n.)	16,551.92*	23,300.10
2724	Division Garage Equipment (Incl. Operation)	13,971.54*	281.55
2726	Division Communication System	3,139.19	20,043.54
2727	Camp Operation (Incl. Boarding Houses)	29,736.32	119,388.98
2792	General Administration	32,400.62	135,609.89
2793	General Engineering	33,096.71	108,211.77
2794	Law Expenses During Construction		5,431.38
2797	Miscellaneous Construction Expenditures	1,417.46	2,550.65
L-73	Electric Energy from Hetch Hetchy Plants	34,071.00*	168,429.13*
	Total	$1,983,595.07	$ 7,926,672.04

Code	Account	Fiscal Year 1928-1929	Total to June 30, 1929
	San Joaquin Division		
3301	Preliminary Investigations & Surveys	$ 50.00	$ 1,148.75
3302	Field Engineering and Inspection	92.92	92.92
3318	Lands & Rights of Way	292.00	292.00
	Total	$ 434.92	$ 1,533.67
	Coast Range Division		
3400	Division Administration & Engineering	$ 39,775.49	$ 61,689.79
3401	Preliminary Investigations & Surveys	10.57*	52,559.33
3402	Field Engineering and Inspection	42,974.78	58,891.77
3403	Camps	135,668.62	305,481.56
3404	Roads, Trails and Tramways	43,910.20	111,963.32
3406	Shafts	232,892.59	659,368.23
3407	Aqueduct Tunnels	1,473,082.04	1,493,542.27
3409	Alameda Creek Crushing Plant	231.27	231.27
3414	Miscellaneous Jobbing and Sales Account	416.07	2,128.99
3415	Equipment Rentals	772.50	
3416	Division Shops & Equipment (Incl. Operation)	69,082.81	89,561.97
3417	Division Warehouse (Incl. Operation)	18,517.63*	1,533.70*
3418	Lands and Rights of Way	50,496.42	90,281.85
3419	Power Transmission Line for Constr. Purposes	24,660.94	236,457.27
3420	Div'n. Administration Buildings and Equipment	4,917.82	6,377.52
3421	Division Hospital (Incl. Operation)	12,366.08*	11,482.44*
3422	Materials & Supplies	379,732.21	533,703.81
3424	Division Garage Equipment (Incl. Operation)	2,975.90	1,989.16
3426	Division Communication System	3,475.23	23,705.50
3427	Camp Operation (Including Boarding Houses)	32,142.01	49,203.01
3492	General Administration	33,428.88	45,530.19
3493	General Engineering	38,459.21	65,046.98
3494	Law Expenses During Construction	5,322.50	5,648.10
3496	Taxes During Construction	15.27	15.27
3497	Miscellaneous Construction Expenditures	247.59	810.83
L-73	Electric Energy from Hetch Hetchy Plants	28,706.23*	34,100.97*
	Total	$2,555,079.84	$ 3,847,070.88

Note: Asterisk (*) denotes credit.

General and Miscellaneous

A-12	Accounts Receivable — Miscellaneous Debtors	$ 114.68*	$ 2,219.01
A-13	Accounts Receivable—H. H. Power Operative Fund	2,706.51	2,706.51
A-16	City Engineer's Revolving Fund	10,000.00	10,000.00
A-17	Hetch Hetchy Pay Roll Revolving Fund	94,000.00	94,000.00
A-18	Remittances in Transit	80,607.35*	44,822.32
A-25	Unamortized Expense on Bonds Sold:		
	H. H. W. C. Bonds (Issue of 1925)		6,461.00
	H. H. C. Bonds (Issue of 1928)	11,350.00	11,350.00
	Total	$ 37,334.48	$ 171,558.84
	Total Net Expenditures	$4,576,444.31	$11,946,835.43

Note: Asterisk (*) denotes credit.

Reconciliation of Statement of Expenditures With Consolidated Statement of Funds

1925 and 1928 Funds

Disbursements As Per Consolidated Statement of Funds:		
1925 Bond Fund	$9,892,510.33	
1928 Bond Fund	1,692,433.60	$11,584,943.93
Accounts Taken Into Expenditures As of June 30, 1929: (not taken up by Auditor until after July 1, 1929)		
Purchase Order Liability	$ 178,551.13	
Accounts Payable, Due on Contracts 113C & E	58,380.27	
Accounts Payable, 1910 Water Construction Fund	53,195.50	
Accounts Payable, Miscellaneous Creditors	4,567.20	
Accounts Payable, S. F. City Employees' Retirement System	644.59	
Accrued on Contract 113C, Progress Estimate (2% withheld in accordance with Contract)	36,331.35	
Accrued on account of Compensation Ins. Premiums	12,582.60	
Accrued on account of royalties—concrete gun	17,638.86	361,891.50
Net Expenditures As Per Detailed Statement (above)		$11,946,835.43

Expenditures on Hetch Hetchy Project
June 30, 1929

Hetch Hetchy Operative Revenue Fund

Total Receipts		$1,967,969.00
Transferred to Bond Interest Fund	$620,000.00	
Transferred to P. G. & E. & G. W. P. Co.s' Evaluation	355,207.66	
Transferred to H. H. 1910 Water Construction Fund	992,733.28	1,967,940.94
Balance available, June 30, 1929		$ 28.06

Hetch Hetchy Power Operative Fund
Condensed Balance Sheet

Assets and Other Debits		From Operation	1909 & 1910 Bond Issues and General Fund	Total per Gen'l. Ledger June 30, 1929
Investment in Fixed Capital		$ 230,315.41	$25,337,374.87	$25,567,690.28
Current and Accrued Assets		1,322,655.52	21,315.85	1,343,971.37
Special Funds, (Depreciation)		508,041.33		508,041.33
Deferred Debits		269,446.78*	1,569,809.38	1,300,362.60
Total Assets and other debits		$1,791,565.48	$26,928,500.10	$28,720,065.58
Liabilities and Other Credits				
Capital and Long-term debt		$3,245,755.96*	$26,928,500.10	$23,682,744.14
Current and Accrued Liabilities		851,842.52		851,842.52
Reserve for Depreciation		521,625.33		521,625.33
Appropriated Surplus		2,294,517.18		2,294,517.18
Additions and Betterments	$ 246,117.18			
Sinking Funds, Retirement of 1910 Bds.	2,048,400.00			
Unappropriated Surplus		1,369,336.41		1,369,336.41
Profit & Loss after comparison charges	1,073,321.15			
Taxes charged for comparison	498,833.07			
Revenues credited for comparison	202,817.81*			
Total Liabilities and Other Credits		$1,791,565.48	$26,928,500.10	$28,720,065.58

Note: Asterisk (*) denotes deduction.

Expenditures on Hetch Hetchy Project
June 30, 1929

Hetch Hetchy Power Operative Fund
Income Statement

Income From Operating Properties	Fiscal Year 1928-1929	Total to June 30, 1929
Operating Revenues:		
Moccasin Power House	$7,279,050.23	$31,818,804.07
Early Intake Power House	23,072.65	179,747.87
Total Operating Revenues	$7,302,122.88	$31,998,551.94
Operating Expenses:		
Production	$ 152,679.63	$ 580,327.07
Transmission	27,358.77	97,466.77
Distribution	7.62	152.45
Commercial Department	5,318,225.63	23,247,147.99
General & Miscellaneous	215,205.25	760,255.36
Total Operating Expenses	$5,713,476.90	$24,685,349.64
Net Operating Revenue	$1,588,645.98	$ 7,313,202.30
Deduct Taxes Assignable to Operations	5,597.78	16,816.69
Net Operating & Gross Income	$1,583,048.20	$ 7,296,385.61
Deductions From Gross Income		
Interest on Long-term Debt	$ 829,561.50	$ 3,346,672.50
Miscellaneous Interest Deductions	4,320.84	46,225.12
Amortization of Debt Discount & Expense	61,844.45	239,634.40
Total Deductions	$ 895,726.79	$ 3,632,532.02
Net Income	$ 687,321.41	$ 3,663,853.59
Disposition of Net Income		
Appropriated for Additions & Betterments	$ 44,851.17	$ 246,117.18
Appropriated for Retirement of 1910 Bonds	512,100.00	2,048,400.00
Total Appropriations	$ 556,951.17	$ 2,294,517.18
Balance for Actual Surplus	$ 130,370.24	$ 1,369,336.41
Charter Requirements for Comparison		
Add. Revenue Chg'd. H. H. W. S. Construction	62,777.23	202,817.81
	$ 193,147.47	$ 1,572,154.22
Deduct Taxes	89,274.85	498,833.07
Balance After Comparison Charges	$ 103,872.62	$ 1,073,321.15

Expenditures on Hetch Hetchy Project

June 30, 1929

Addenda

Interest Received On Bay Development Expenditures

	Principal	Interest
April 18, 1922, to May 31, 1924		$ 58,232.05
June 1, 1924, to April 17, 1925	$4,796,086.43	170,451.54
Transferred to 1910 Bond Interest Fund		$ 228,683.59

Interest Received on Accounts Receivable and Surplus Funds Invested

July 1, 1919, to June 30, 1926 (1910 Bond Fund) Credited to 1910 Bond Interest Fund	$2,910,471.16
November 1, 1918, to June 30, 1924 (Hetch Hetchy Operative Revenue Fund)	
Accounts Receivable Hetch Hetchy Railroad	$ 19,006.67
Surplus Funds Invested	5,735.00
Credited to Hetch Hetchy Operative Revenue Fund	$ 24,741.67

Receipts From Water Crop

Waterford Irrigation District	$ 750.00
Turlock Irrigation District	90,000.00
Modesto Irrigation District	74,229.17
	$ 164,979.17
Sales from Golden Rock Ditch	1,345.33
Credited to Hetch Hetchy Operative Revenue Fund	$ 166,324.50

Revenues From Use of Pipe Line—Bay Development

September 19 to December 31, 1925	$ 24,600.78	
January 1 to April 22, 1926	26,472.40	
May 21 to June 30, 1926	28,082.17	
July 1, 1926, to June 30, 1929, Earned @ $250,000 Per Yr.	750,000.00	
July 1, 1929, to June 30, 1930, Unearned	250,000.00	$1,079,155.35

Accounting for the foregoing:

Received and deposited in Hetch Hetchy Operative Revenue Fund			$ 24,600.78
Received and deposited in 1910 Bond Fund:			
Advance Payments		$1,000,000.00	
Discount in accordance with Order of California Railroad Commission of Dec. 18, 1924 (Decision 14379) and Ordinance No. 6447 of Board of Supervisors, approved Dec. 22, 1924,	$175,562.50		
Less amount unpaid	58,953.14	116,609.36	883,390.64
Receivable from S. V. W. Co.			54,554.57
Discount chargeable to Interest During Construction			175,562.50
			$1,138,108.49
Less amount payable to S. V. W. Co., additional discount			58,953.14
Revenues as shown above			$1,079,155.35

HETCH HETCHY PROJECT

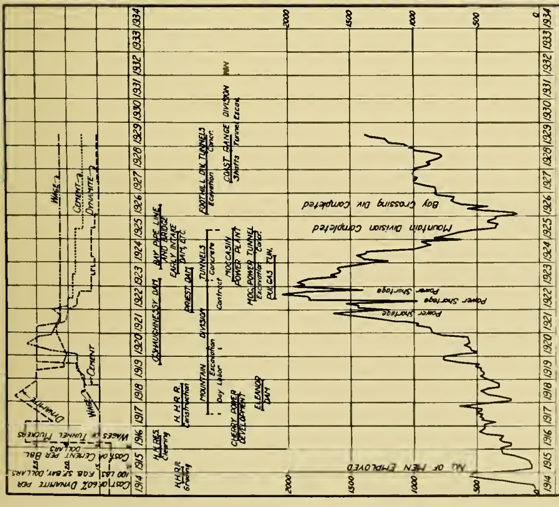
CONSOLIDATED STATEMENT OF FUNDS - JUNE 30, 1929

	BOND ISSUES				General Fund	H.H.Operative Revenue Fund	Hetch Hetchy Power Operative Fund	Hetch Hetchy Power Depreciation Fund	TOTALS
	1909	1910	1925	1928					
RECEIPTS:	$	$	$	$	$	$	$	$	$
Par Value of Bonds Sold	600,000.00	45,000,000.00	10,000,000.00	4,000,000.00					59,600,000.00
Add Premiums, Sale of Bonds	3,050.00	11,348.00	107,211.00						121,609.00
Deduct Discount " " "		2,980,326.55							2,980,326.55
Net Proceeds " " "	603,050.00	42,031,021.45	10,107,211.00	4,000,000.00					56,741,282.45
Advanced from General Fund					118,151.02				118,151.02
Transferred from 1909 & 1910 Funds to General Fund	16.13*	52.78*			68.91				
Interest Earned on Funds Invested						5,735.00			5,735.00
Advance Payments by Spring Valley Water Co. $1,000,000.00 Disc't. 175,000.00 Unpaid 58,953.14 116,609.36		883,390.64							883,390.64
Operation of Hetch Hetchy Railroad						1,380,876.87			1,380,876.87
Sale of Power, Lower Cherry Power Development						386,338.54			386,338.54
Sale of Water						166,324.50			166,324.50
Use of Pipe Line, Bay Development						24,600.78			24,600.78
Miscellaneous						4,093.31			4,093.31
Operating Revenues							8,532,115.24		8,532,115.24
#Depreciation Reserve transferred from Operative							593,749.00*	593,749.00	
TOTAL RECEIPTS	603,033.87	42,914,359.31	10,107,211.00	4,000,000.00	118,219.93	1,967,969.00	7,938,366.24	593,749.00	68,242,908.35
DISBURSEMENTS:									
For construction of project and operation of utilities # except depreciation expense which is shown as a transfer above	603,033.87	42,913,614.27	9,892,510.33	1,692,433.60	118,219.93	992,733.28	1,139,946.87		57,352,492.15
For charges to Depreciation Reserve								85,707.67	85,707.67
For Bond Interest, transferred To Bond Interest Funds						620,000.00	4,473,471.00		5,093,471.00
For Bond Redemption, transferred to Bond Redemption Funds							1,269,529.00		1,269,529.00
For Calif. Railroad Commission Evaluation (P.G.& E. & G.W.P. Plants in San Francisco)						355,207.66			355,207.66
TOTAL DISBURSEMENTS	603,033.87	42,913,614.27	9,892,510.33	1,692,433.60	118,219.93	1,967,940.94	6,882,946.87	85,707.67	64,156,407.48
CASH BALANCES-JUNE 30,1929		745.04	214,700.67	2,307,566.40		28.06	1,055,419.37	508,041.33	4,086,500.87

* Indicates deductions

Contractual Liabilities, Hetch Hetchy Water Construction Fund

Contr. No.				
113	Construction of Aqueduct Tunnels—Foothill Division			
"C"	A. Guthrie & Co.—Rock River & Oakdale Sections			
	Amount of Contract		$1,257,952.50	
	Excess of actual quantities over original estimate		317,126.81	
	Allowances account of placing permanent timber		476.78	
			$1,575,556.09	
	Deductions:			
	Labor & Material furnished by City	$ 163,199.50		
	Progress Payments to Contractor	1,297,025.94	1,460,225.44	
	Balance due on Contract			$115,330.65
"E"	T. E. Connolly & J. M. DeLuca—Brown Adit Section			
	Amount of Contract		$ 779,745.00	
	Excess of actual quantities over original estimate		24,508.57	
	Allowances account of placing permanent timber		260.08	
			$ 804,513.65	
	Deductions:			
	Labor & Material furnished by City	$ 125,180.05		
	Overbreak in Tunnel Excavation	2,940.98		
	Progress Payments to Contractor	675,192.62	803,313.65	
	Balance due on Contract			$ 1,200.00
119	Outlet Gates and Appurtenances—Moccasin Re-Reg. Reservoir			
	Joshua Hendy Iron Works, Amount of Contract		$ 13,798.00	
	Less Progress Payments to Contractor		9,658.60	
	Balance due on Contract			$ 4,139.40
	Balance			$120,670.05



HETCH HETCHY WATER SUPPLY OF THE CITY AND COUNTY OF SAN FRANCISCO, CALIFORNIA

UPPER: GRAPHIC RECORDS OF COSTS OF LABOR AND MATERIALS.

LOWER: GRAPHIC RECORD OF NUMBER OF MEN EMPLOYED.

NOTE: EMPLOYEES IN THE SAN FRANCISCO OFFICES ARE NOT INCLUDED IN THE COUNT.

DEPARTMENT OF PUBLIC WORKS. APPROVED M. M. O'Shaughnessy CITY ENGINEER

BY I.M.L. TRACED I.M.L. CHECKED [illegible]

SCALE As shown DATE As posted

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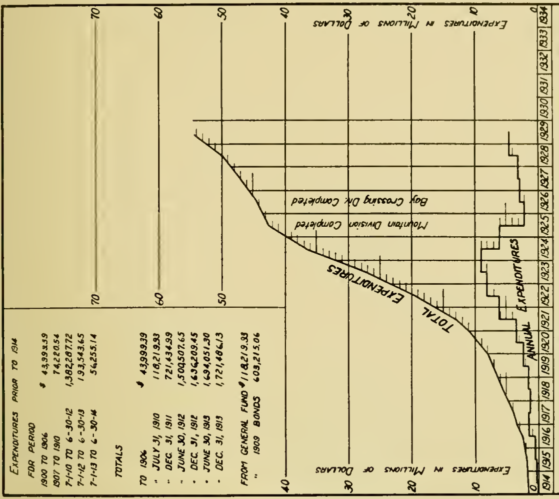

EXPENDITURES PRIOR TO 1914

FOR PERIOD	
1900 TO 1906	$ 43,999.39
1907 TO 1910	74,220.54
7-1-10 TO 6-30-12	1,382,287.72
7-1-12 TO 6-30-13	193,543.65
7-1-13 TO 6-30-14	56,255.14

TOTALS	
TO 1906	$ 43,999.39
" JULY 31, 1910	118,219.93
" DEC. 31, 1911	721,434.99
" JUNE 30, 1912	1,500,507.65
" DEC. 31, 1912	1,636,209.45
" JUNE 30, 1913	1,694,051.30
" DEC. 31, 1913	1,721,486.13
FROM GENERAL FUND	$ 118,219.93
" 1909 BONDS	603,215.06

HETCH HETCHY WATER SUPPLY OF THE CITY AND COUNTY OF SAN FRANCISCO, CALIFORNIA

GRAPHIC RECORDS OF

ANNUAL AND TOTAL EXPENDITURES.

DEPARTMENT OF PUBLIC WORKS. APPROVED M. M. O'Shaughnessy CITY ENGINEER

BY I.M.L. TRACED I.M.L. CHECKED [illegible]

SCALE As shown DATE As posted

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MATERIIS MEIS PERFECTIONEM PETO

A. F. HEUER
509 Sansome Street
San Francisco

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